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# Site evaluation for an arboretum in central Iowa

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# SITE EVALUATION FOR AN ARBORETUM IN CENTRAL IOWA

by

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# INTRODUCTION

Presettlement survey notes indicate that the Iowa landscape was dominated by prairie (21). It was described as tall-grass prairie with deciduous forests located along major stream systems in the central and west regions with the east region being the most dense (38, 51, 5, 28, 59). MacDonald (43) reported that 19.3 percent of the landscape was covered by forest. This is an estimate which has been reduced to 16 percent by a later study (21). Since the 1830's, when the original survey was made, the forest has been reduced to 7.3 percent (31) and almost all of the prairie has been converted to crop land (55). Commercial cutting of wooded areas continues to reduce the forest area which is the only natural vegetation type of any consequence in the state.

Understanding these changes in the landscape, a group of community leaders, working through the Iowa Horticultural Society, considered the establishment of an arboretum in Iowa. Forty acres of land were purchased in 1968 to begin a project called "Iowa Arboretum, Incorporated." This project includes an additional 300 adjacent acres leased from the Iowa 4-H Camping Center.

## PURPOSE AND SCOPE

This study was undertaken in cooperation with the director of the Iowa Arboretum to assist in recommending a procedure for the development of this area. Primary interest was devoted to forest-tree associations, their locations and composition. This study includes descriptions of the 340 acres and an analysis of factors related to the overstory vegetation.

The Arboretum site was divided into 124 study areas, each of which was diagramed and described. Descriptions include listings of woody vegetation and characteristics of each area. Diagrams locate vegetation and physical conditions such as erosion, animal trails, and dead trees. These descriptions are compiled on maps of the entire site and are utilized in recommending procedures for development of the site with location of foot trails, roads and parking areas.

# LITERATURE REVIEW

## Location

The Iowa Arboretum is located three miles southwest of Luther, Iowa, in Boone County and is comprised of portions of Sections 2, 3 and 11 of Douglas Township. A line between Sections 2 and 3 divides the site into two equal areas of 160 acres each. Richardson's Branch flows through the area over an extensive floodplain of alluvial and colluvial deposits. The stream has increased in size since its first reference in a land survey. In 1847, its width was measured and recorded as 4 to 6 links, a distance of 32 to 48 inches (58). Today its width averages 72 inches as a result of increased runoff from cultivated fields in the watershed. A number of wet-weather springs flow into the stream from ravines adjacent to the floodplain.

## History

Since settlement, the summits above the floodplain have been cultivated, and some timber has been removed from the slopes. Cattle were grazed over portions of the land including a few slopes. These practices were discontinued in 1950, when the land was purchased by the 4-H Club (7). Portions of the "summits" are still cultivated through contracts with the 4-H Camp. The slopes and floodplain have since been fenced and remain undisturbed since 1950.

To better understand the vegetation currently represented over a region, it is important to know as much as possible about past practices. A number of techniques have been utilized in gathering such information. In areas where representative samples of native vegetation have been preserved, it is possible for investigators to compare current conditions to the characteristics of virgin areas. This approach is of little value in Iowa since all but a a few acres of virgin prairie and forest have fallen to the plow and axe. Historical literature sometimes reveals facts about past vegetation, but few records of presettlement vegetation are available concerning the Midwest. Information in the past has been received from personal contacts with natives of particular regions. As time claims older generations, this source is lost forever.

The most popular and successful method of historical documentation is the mapping of presettlement vegetation from notes kept by surveyors as they surveyed the land. Trees were used as reference points by these men, and their notes have supplied valuable information concerning the location and size of presettlement forest and prairie. This technique was successfully used in Ohio by Sears in 1921 (56). Later, this method was duplicated by a number of investigators with similar results (35, 52, 30, 41, 20, 21, 10, 34).

Utilizing this procedure, the original survey notes indicate that the arboretum area is, at present, topographically similar to what it was in 1847, and that the forested area at that time contained maple, oak, linden, walnut, elm, hickory and ironwood (58). The wooded slopes presently contain all of these species, giving evidence that the forest species present has not been drastically altered. Survey records indicate that the summit regions were under prairie vegetation as indicated by the remarks, "entered timber," recorded at a point along one side of the arboretum property. In regard to Douglas Township, the surveyor writes:

> The prairie in this township is generally level and near the timber, wet. It is filled with small ponds, but the land is good. The timbered land is very broken. The bottoms are small, but rich and well timbered with fine growth of W & B walnut, sugar & C (58).

A reproduction of the original township map (Fig. 1) shows the location of topographic features with the addition of an outline showing the arboretum in relation to the township. It might be noted when comparing the original map with more detailed maps in the Appendix that the second fork of Richardson's Branch was not indicated by the surveyors. This was omitted on the original map because transit lines do not travel through the location of this stream.

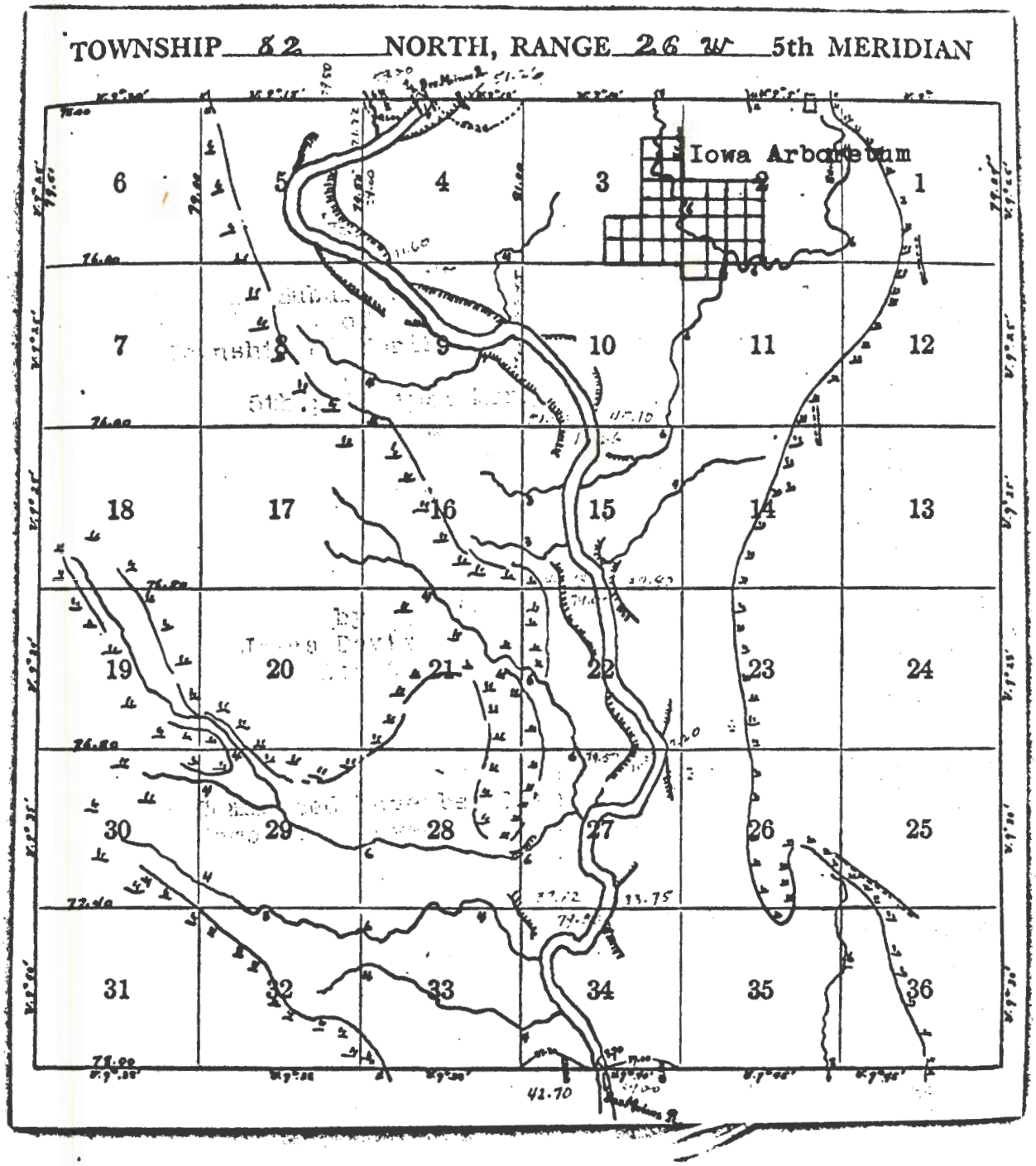



Fig. 1. Original survey map of Douglas Township in Boone County indicating Iowa Arboretum (58)

## Vegetation

Since the prairie, which was once part of the total plant community, has been entirely destroyed, this discussion will not include specific information concerning its composition. Instead, it will deal with the present wooded associations covering the side slopes, shoulder slopes, and floodplain in the arboretum.

Considerable attention has been focused on attempts to determine climax vegetation for specific regions, that is, the highest vegetation type surviving under a particular climate (61). This term is vague and might be eliminated from ecological descriptions. Community composition changes with each season, as living processes normally do. To consider any form as a static entity, as climax does, is to eliminate the mechanisms of change. A better definition for this term would be to describe the most efficient community to survive under given climatic conditions. In terms of climax, Iowa has been described as prairie (57, 61) and forest climax (12, 29, 35, 42), giving testimony to the vagueness of the nomenclature. Forests were thought to be climax for Iowa by Gleason(29), who contends that deciduous forests are moving into the prairie regions at a more rapid rate, since settlement has lessened their destruction by fires believed started by Indians.

Observations by McComb and Loomis (42) suggest that the forest is moving into prairie areas. This observation

is supported by more recent composition studies made by Dick-Peddie (21). Most suggestions are valid assumptions supported by short-term experiments. Forest communities are long-lived, and only long-term experiments will solve the questions related to changes in their composition and establishment. As future generations compare records of today with communities of the future, a better realization of behavior might be formulated.

More specific studies related to forest composition and growth were obtained by the establishment of permanent plots in forested regions which are available for periodic and repeated measurements. The first attempt of this kind in Iowa was made by McLintoch (44) in Lucas County. His measurements were used to determine growth rates and yields for judging stand conditions. This technique is commonly used since it is the only dependable method of determining accurate data on trends in composition.

## Factors Which Limit Vegetation

Forces and factors of nature increase the difficulty of studying forest complexes. The biological processes of the individuals involved, and the effects of environmental conditions upon these units create cycles of involved phenomena. In order for a community to survive, it must possess the capacity to reproduce. A study, which can be related to most forest species, was made by Watt (60) who

explored the limiting factors in the regeneration of oaks. Factors were grouped into one of three classification units: first, enemies of acorns before germination; second, factors affecting germination power; and third, limiting conditions after the seedlings have become established. Animals were blamed for the disappearance of acorns which were not covered by the first of December. It was shown that bare soils as well as those with thick mats of vegetation covering the surface prevented the germination of acorns by preventing the radicle from penetrating the soil. Where the micropyle was submerged and pointed downward, there always seemed to be a successful germination. Growth of seedlings was limited by animals, fungi and density of the stand. These limitations are not unique to oak and could be applied to most species in the forest complex.

As forested areas are reduced, animal densities generally increase in the remaining forests. This increase in population created greater stress on the vegetation. Many investigators (46, 40, 19, 22) have studied the effects of grazing and concluded that it limits regeneration by destruction of seedlings and reduced soil moisture by destruction of ground cover.

Fire, natural or man-made, has drastic effects on the forest complex. Large amounts of organic matter are burned and lost along with vast amounts of nitrogen. Isaac

and Hopkins (32) attribute the loss of 435 pounds of nitrogen per acre and a change in pH from 4.95 to 7.60 on the surface to fires in the Douglas fir region. Eneroth (26) contends that the reduction in acidity is beneficial and measured an increase in absorbed lime in the humus layer. Other benefits of burning were reported by Molchanov (45) concerning increased seedling survival with the reduced litter layer that prevents root penetration and increased mineralization of humus following fires.

Climatic factors influence the forest composition, and studies have included many facets of its role. Nitrogen metabolism was studied in regard to temperature indicating that bacterial activity varies with temperature as does the carbon-nitrogen ratio which becomes less as the temperature increases (33). Tree growth has been correlated with moisture by a number of investigators (16, 36, 54) who concluded that there is a direct relation between ring expansion and moisture availability.

In Iowa, Aikman and Smelser (2) as well as Kucera (37) have studied the environmental condition in central Iowa regarding forest patterns and others (9, 11, 25) have related these conditions to forests in the Midwest. Vast amounts of such data are available and do not warrant mention here.

The majority of the forest complex within the arboretum is located on slopes between the summit and floodplain. It is important to consider slope, aspect and topography in

relation to vegetation as many workers have done in the past. Weaver and Clements (61) conclude that soil water is influenced by slope steepness, since drainage and runoff are affected. Soil depth has been correlated to slope by thickness and development (50, 53). Taller trees were found to grow near the base and were related to soil depth (4). The degree of slope and topography have been cited as responsible for differences in site index (15) and height of dominant trees at a specified reference age since they influence temperature and ability of reproduction.

Aspect has similar effects on vegetation, since it causes differences in moisture and temperature. A correlation was shown between tree growth and aspect by Dilworth (23), concluding that north and east slopes were more moist, hence supporting faster growth; and the south and west slopes were drier. Similar increases were shown in relation to the site index of yellow poplar on equivalent slopes. There was a 17-point increase on these moist exposures (6). Bates (8) states that some tree species distributions are entirely related to this temperature and moisture variation in the Rocky Mountains. In Idaho, it was shown that in summer months the southwest slopes were dangerously dry with associated high temperatures as compared to northeast slopes (39). In Iowa, the most xeric condition is represented by the west exposure with mesophytism increasing south, east, and north, respectively (1).

All of the factors mentioned must be correlated to the complexes under study. It is obvious that the vast number of influencing factors make any conclusion about forest composition and quality difficult.

Measuring techniques have been devised to accommodate specific qualities of the forest, but none have been developed to record simple descriptions of communities for use in development. Visual examination of an area is important only if accurate documentation of notes can be made. This report will utilize a new approach to recording site analysis of areas with varying topography.

# METHODS

Aikman and Smelser (2) suggest that maple-basswood communities are the highest stage of forest development in central Iowa, while Kuchler (38) maps potential natural vegetation for central Iowa along streams to be oak-hickory. Braun (13) contends that Iowa is a transition zone with oak-hickory and maple-basswood associations merged. This discrepancy can only be solved by measurement over long periods of time that will indicate what direction the associations are moving. The survey method used in this study provides enough detail to utilize its measurements in comparison to future surveys.

To analyze the arboretum site with maximum detail, the 340 acres were divided into 124 study areas separated by four criteria: (1) slope; (2) exposure; (3) composition; and (4) dominant vegetation. Each was visually surveyed describing physical conditions and outstanding characteristics in a report that accompanies schematic diagrams of the overstory in each study area. Descriptions of each area were grouped by common types to determine which area supported the various forest associations in central Iowa.

Fig. 2 is a photograph showing overstory vegetation on a typical north-and-south facing slope with a schematic diagram of the same areas. In order to understand the survey system, it will be necessary to correlate the

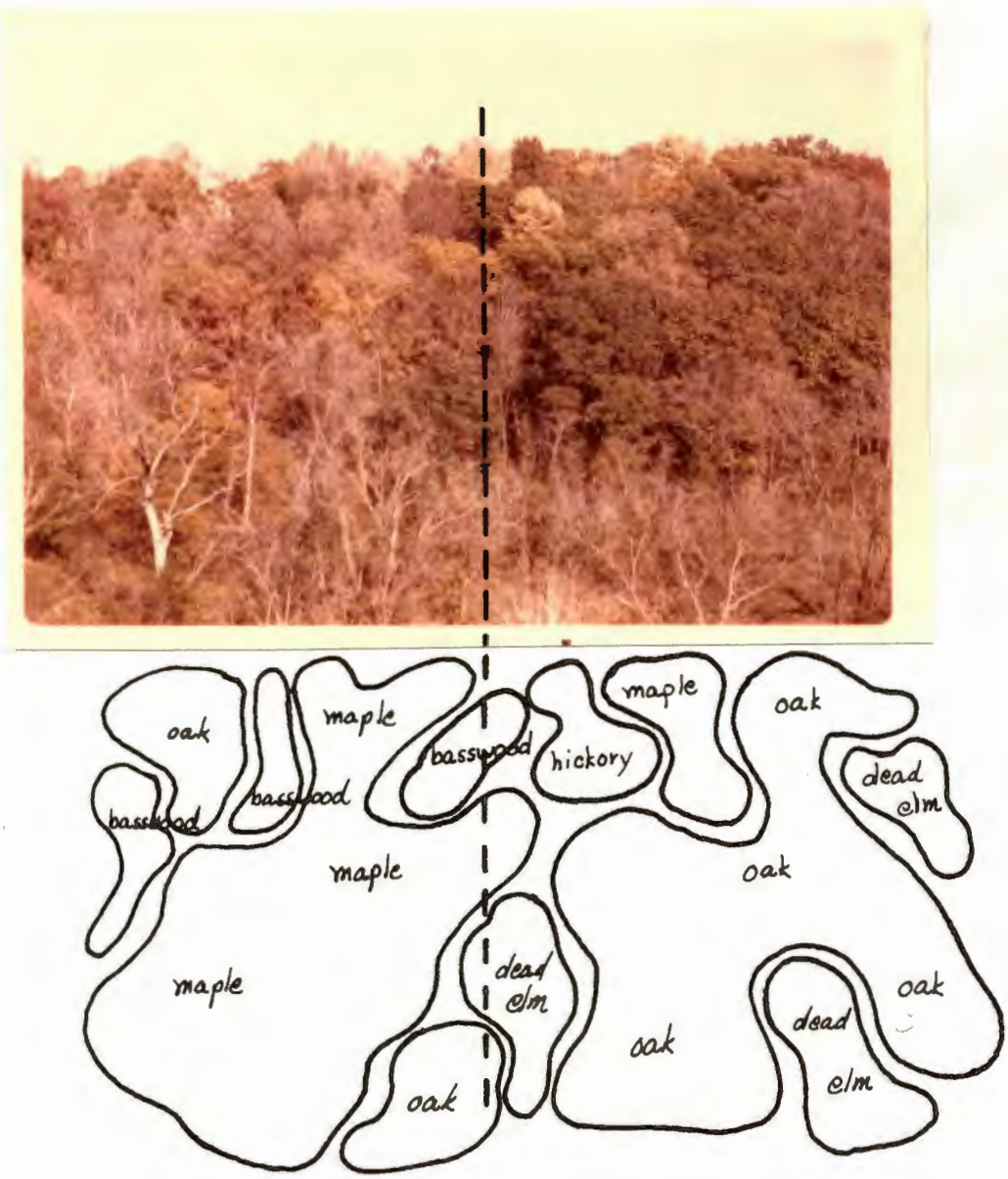



Fig. 2. Photo of typical north and south exposed slopes (left, north exposure; right, south exposure) and schematic diagram of the dominant overstory associations

representation in the diagram with actual canopy. The diagram gives no indication of the number of trees producing the canopy, but only the percentage of surface covered by canopy of similar species. By estimating these percentages, the vegetation of the area can be classified to the type it best represents.

Types or associations are classified by simple criteria. Any single species or group of species which covers 55 percent or more of the overstory constitutes an association type. For example, in Fig.2, 40 percent of the total canopy of the southerly exposed area is represented by oak species and 20 percent by hickory. This denotes dominance by oak and hickory and constitutes an oak-hickory association. Some areas are dominated by only one species and carry that name as an association type, while others show dominance with three species and carry a three-name association. Thirteen different association types were found on slopes, three on summits, and one over the floodplain.

Directional arrows are placed on each diagram. Elm trees are recorded when found alive without signs of infection by Dutch elm disease.

# DESCRIPTION

## Vegetation and Other Physical Characteristics

### Study Area 1

This area is located on the northern boundary of the arboretum site as shown on Fig. 121. It is bound on two sides by fences and on one side by Richardson's Branch. The slope is approximately 160 feet wide and 100 feet deep with a vertical drop of 90 feet. The surface is straight and has an eastern exposure.

The area appears to have been grazed in the past as the areas beyond the fences are today. There are no trails on the slope which has an even drop from the fence above to the terrace of the floodplain at its base.

The overstory is undergoing a rapid change. In past years elm (Ulmus americana) dominated this slope but their death has changed the slope's appearance. Black maple (Acer nigrum) and bur oak (Quercus macrocarpa) dominate portions of the slope. Other overstory species present are honey locust (Gleditsia triacanthos) and cottonwood (Populus deltoides). The understory is sparse. This situation should change as species begin their bid to replace the elm. There is an open area near the southern end of the slope where hophornbeam (Ostrya virginiana) and black maple (Acer nigrum) dominate the understory. Juniper (Juniperus

virginiana) is also present at the center of the slope. Understory and litter are sparse on this slope. Excess water from grazed areas above run over this slope removing most of the litter which is produced.

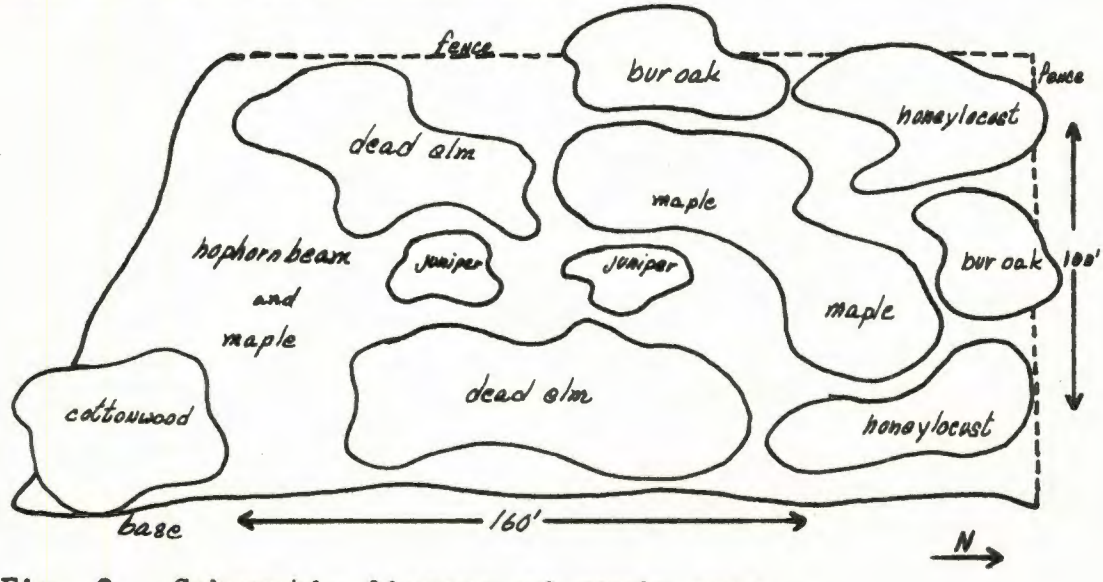



Fig. 3. Schematic diagram of study area 1

Study Area 2

Area 2 is a small slope facing south. The northern edge of this slope is marked by a sharp ridge at the point of its intersection with Area 1. The fence which marks the western edge of the study area is located on this slope. The base of this area is the site of a gorge which is part of a drainage ravine from the adjacent property. Ths slope is only 60 feet wide across its base and 100 feet deep at the western edge.

The overstory completely covers this slope with the exception of one area at the base where an elm (Ulmus

americana) has died opening the canopy. The dominant species are butternut (Juglans cinerea) and basswood (Tilia americana) with one hackberry (Celtis occidentalis) growing on the northern ridge. The understory is not developed and the undercover is sparse. This slope was apparently grazed at one time and is still slightly disturbed by excess water from adjoining property.

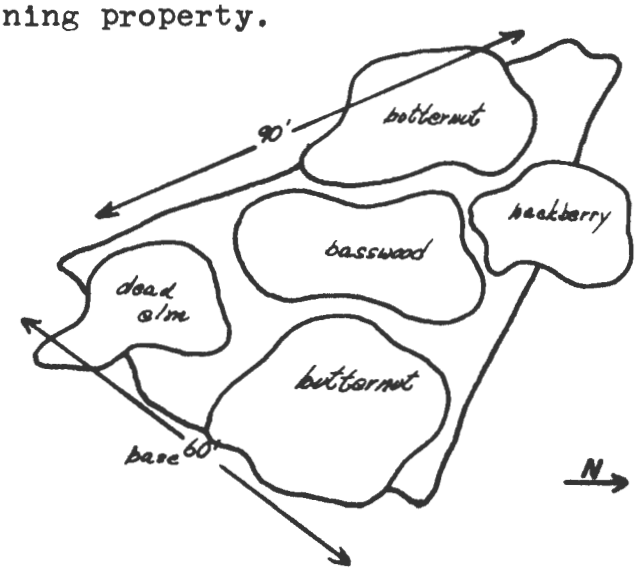



Fig. 4. Schematic diagram of study area 2

Study Area 3

This area is a large peninsular-shaped slope which extends from the fence of the western boundary toward Richardson's Branch. The area consists of three different exposures, but because of the disturbance and sparse vegetation, it will be considered as one area.

The northern exposure of this area is approximately 90 feet deep at its western edge and 180 feet long. The eastern edge slopes down to the plateau of the floodplain. The base

of this exposure is eroded, exposing a wall of soil ten feet deep.

The vegetation in the overstory consists of white oak (Quercus alba) and bur oak (Quercus macrocarpa) on the upper crest of the slope and hackberry (Celtis occidentalis), black walnut (Juglans nigra) and red mulberry (Morus rubra) near the base. All are sparse with only hophornbeam (Ostrya virginiana) as an understory on the western end of the exposure. The undercover is sparse, made up entirely of heavy grasses.

The center exposure faces east. This slope has a gentle grade of 20 degrees. The western edge of this exposure is approximately 80 feet wide, tapering to a point at its base.

The undercover consists only of grass which completely covers the slope. The only woody material on this exposure is one red oak (Quercus borealis) near the top and one dead elm (Ulmus americana) at its center.

The third exposure faces the south, and it like the others is sparsely covered. This exposure has a 50-degree drop for 30 feet and is approximately 100 feet long.

The elm (Ulmus americana) overstory has died, leaving the hophornbeam (Ostrya virginiana) understory as the only woody plants on the slope. The hophornbeam are few in number with a grass undercover and little litter beneath them.

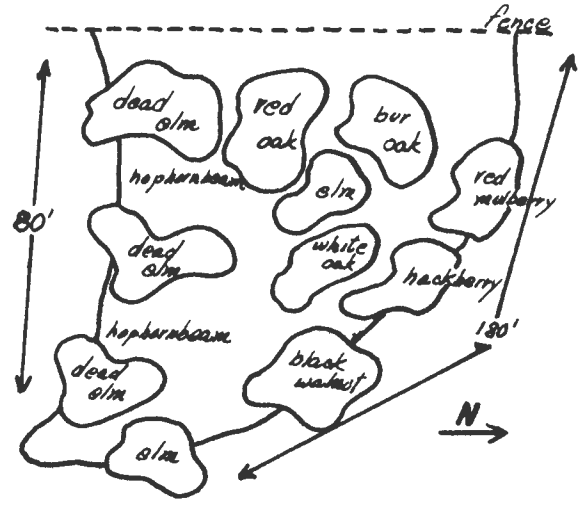



Fig. 5. Schematic diagram of study area 3

Study Area 4

This area consists of a 90-foot slope which faces due north. The slope is free of overstory vegetation except for two clumps of basswood (Tilia americana). There is no understory and a sparse and spotty undercover. Two dead elms (Ulmus americana) are on the center of this slope which will cause considerable changes in the future vegetation of this area, when they are replaced by other species.

Study Area 5

Area 5 is part of an extensive secondary drainage gorge most of which is located on adjoining property. The area is approximately 110 feet long and 100 feet deep. The lower half of the slope has been eroded and remains in an unstable state. A fence marks the western boundary, but because of

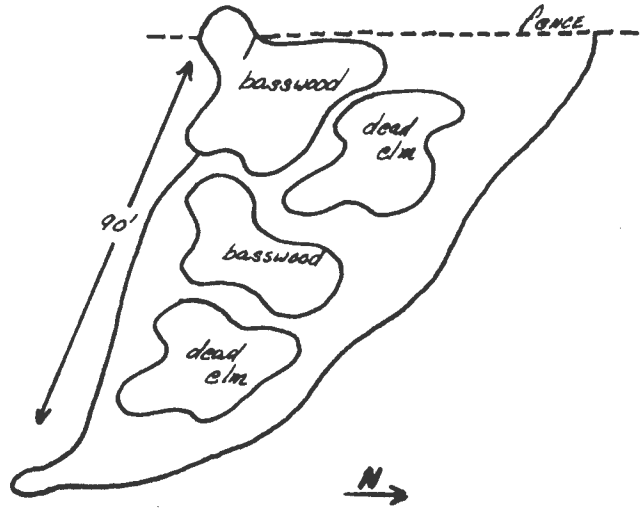



Fig. 6. Schematic diagram of study area 4

severe erosion, the strands of wire are left dangling in mid-air. The upper portion of the slope drops at a 50-degree angle until it reaches the eroded area which drops off at 90 degrees.

The overstory is dense, dominated by oaks (Quercus borealis, Quercus alba). There are also black maple (Acer nigrum), shagbark hickory (Carya ovata) and a number of dead elm (Ulmus americana). The understory is dominated by hop-hornbeam (Ostrya virginiana) with a few small hickory and oak. The undercover is sparse, but the litter is heavy.

Movement on this slope is difficult and there are no animal trails to be found. The erosion problem here is from below and not from excess runoff above, which is usually the case.

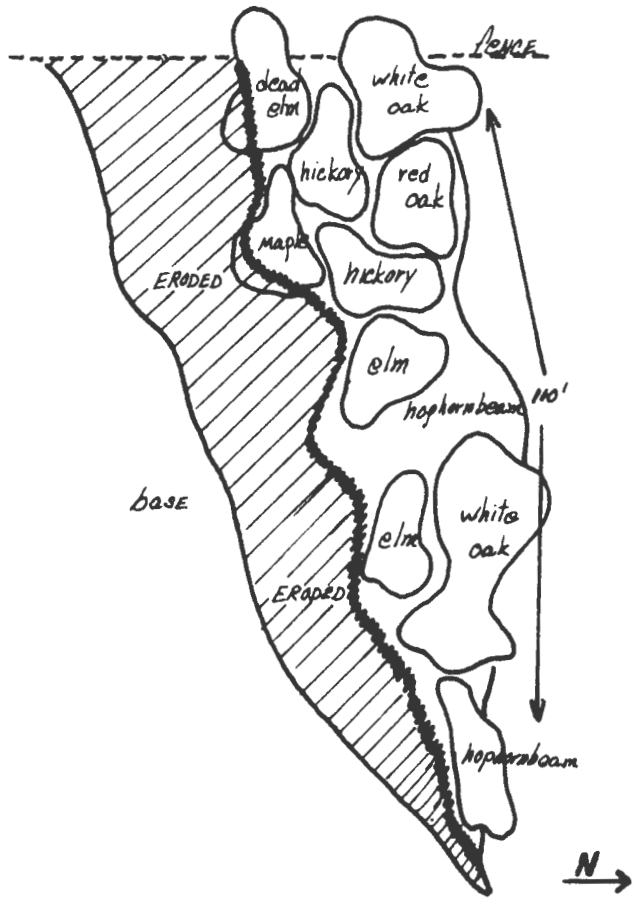



Fig. 7. Schematic diagram of study area 5

Study Area 6

This region is part of a drainage system from neighboring property. The face of this slope is more than 50 percent eroded. Its top ridge is very uneven with an 80-degree slope to the eroded lower edge. The slope faces northwest and extends east from the property-line fence for 130 feet.

The overstory which is located on the top half of the slope is very dense. The dominant species are oaks (Quercus

alba, Quercus borealis), black maple (Acer nigrum) and basswood (Tilia americana). There is also one shagbark hickory (Carya ovata), one serviceberry (Amelanchier canadensis) and one dead elm. There is little understory, and only a few hophornbeam (Ostrya virginiana) are present. The undercover is sparse under this dense cover and totally absent on the eroded sections.

The slope is very steep and difficult to walk on. Here again the problem of erosion is caused from a disturbance near the base which has slowly extended to the condition it is in today.

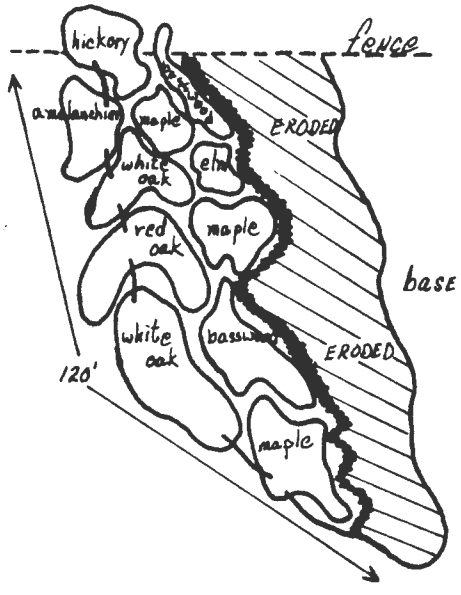



Fig. 8. Schematic diagram of study area 6

Study Area 7

Area 7 is a small portion of sloping woodland facing northeast. The slope is barrel-shaped with a width of approximately 70 feet and a length of 80 feet. The northernmost

portion of the slope is without overstory or understory vegetation. The understory is well developed but not diversified. It is dominated by grasses.

The slope turns to a southerly exposure where black maple (Acer nigrum) and shagbark hickory (Carya ovata) dominate its overstory. There is also a dead elm near its base. The slope again has no understory and a sparse undercover.

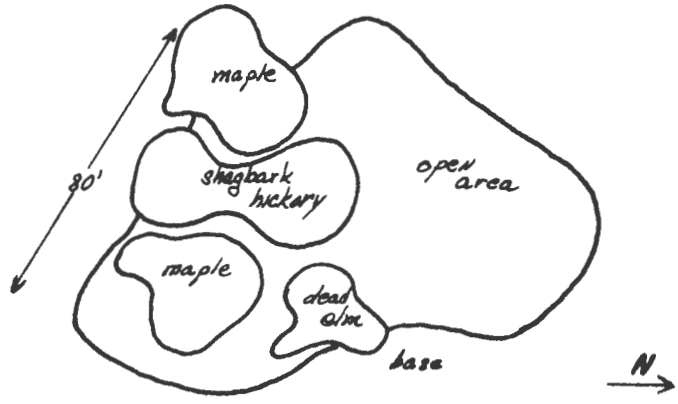



Fig. 9. Schematic diagram of study area 7

Study Area 8

This area is made up of a long convex slope. The slope is only 70 feet high, most of which is eroding. Richardson's Branch is located at the slope's base and is responsible for most of this problem. There is also a spring which opens onto the face of this slope, adding to the problem.

The slope faces easterly with the exception of the northernmost end which faces south. There is no understory

on this slope and little undercover. The eroded portions are totally exposed and subject to further erosion.

The overstory is dominated by oaks (Quercus alba, Q. borealis, Q. macrocarpa) and black maple (Acer nigrum) with one shagbark hickory (Carya ovata) and one black walnut (Juglans nigra). These species cover only 30 percent of the slope, and the remaining 70 percent is either eroded or open with grass cover.

The vertical drop of the non-eroded portion of slope is approximately 70 degrees making it difficult to walk in any direction.

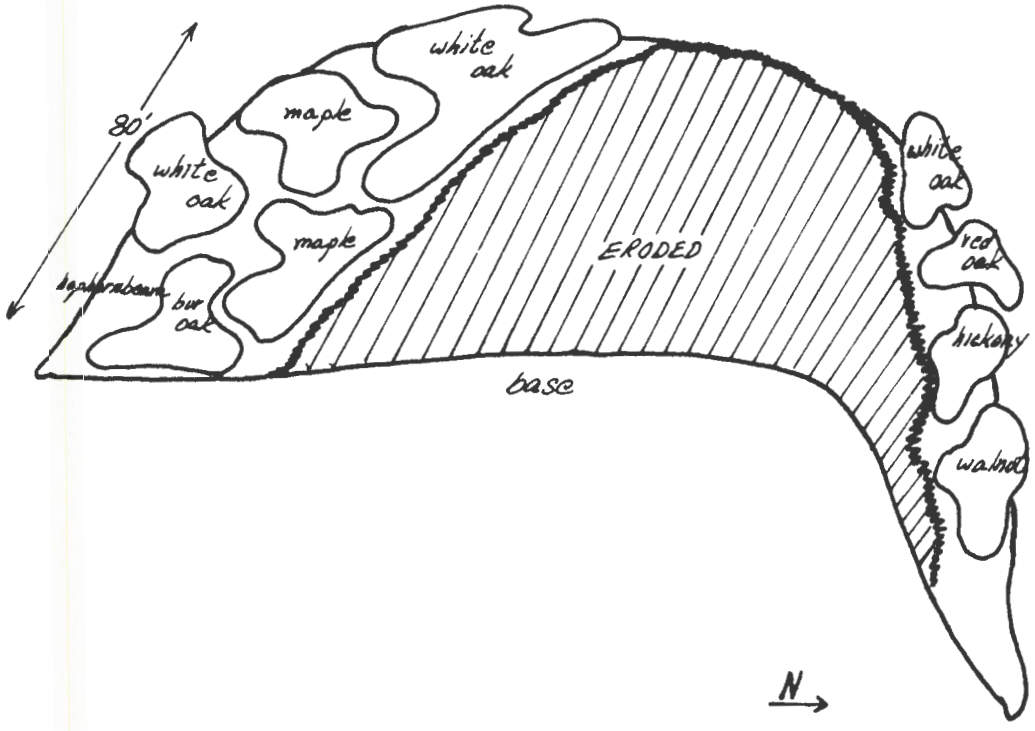



Fig. 10. Schematic diagram of study area 8

Study Area 9

Area 9 is a 160-foot long section of the slope which borders the floodplain of Richardson's Branch. The slope faces east-northeast and shows signs of past disturbance. There are open areas where trees have been removed by loggers and a disturbed understory which gives evidence of past grazing. The slope has a vertical drop of 80 feet with a steep 60-degree grade.

The undercover is thick in the open areas but is very sparse under the canopy. The understory contains sumac (Rhus glabra), honey locust (Gleditsia triacanthos), hophornbeam (Ostrya virginiana) and juniper (Juniperus virginiana). Dominant species in the overstory are oak (Quercus alba, Q. macrocarpa) and black maple (Acer nigrum) with hickory (Carya glabra) and honey locust (Gleditsia triacanthos) in smaller quantities. Both living and dead elm (Ulmus americana) can be found on this section.

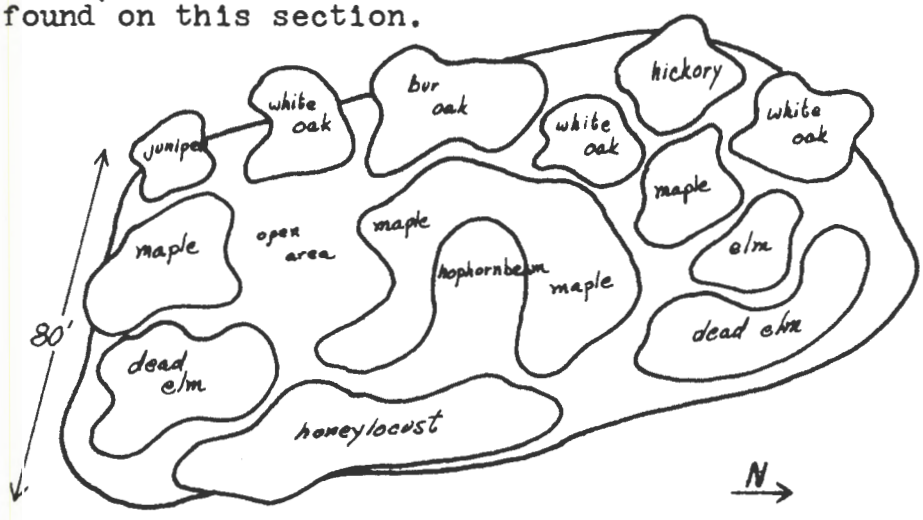



Fig. 11. Schematic diagram of study area 9

Study Area 10

This study area is part of a secondary drainage system. The slope's eastern end extends into Richardson's Branch floodplain and its western approaches the fence on the property boundary. The slope is 200 feet long and ranges from 50 to 80 feet deep. The grade is approximately 70 degrees with no trails or contours apparent. There is one eroded area near the floodplain which exposes an 8-foot wall of soil. The slope is exposed to the southeast and is slightly rolling in its appearance.

The understory and undercover are sparse, except for one open area on the eastern end of the slope. Many species are represented in the overstory with oak (Quercus alba, Q. borealis) black maple (Acer nigrum) and basswood (Tilia americana) dominating. There also are a number of hickory (Carya glabra, C. ovata) and a few black walnut (Juglans nigra) included here. The oaks dominate the upper slope with maple dominating the base. Basswood is also more prevalent on upper surfaces.

Intersection of Area 10 with Area 9 produces a ridge which has a gentle 30-degree drop down to the floodplain. This ridge has a possible use as a trail from the summit down to the floodplain.

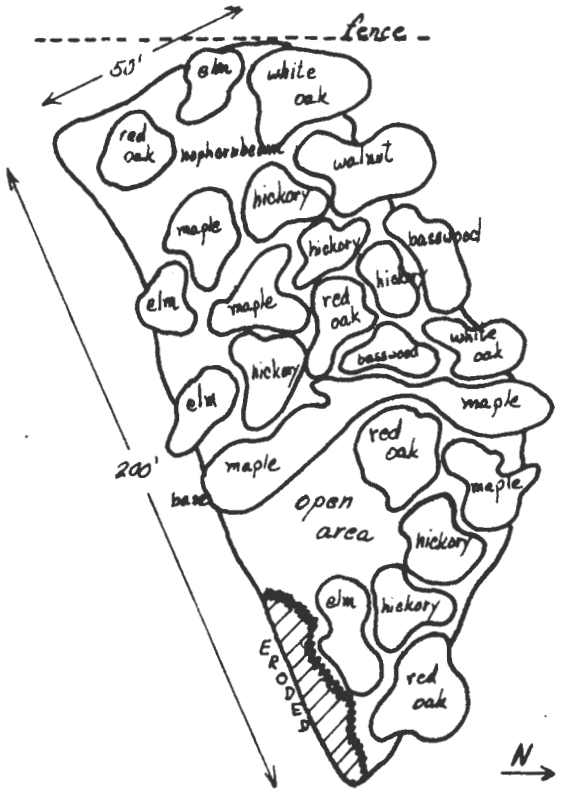



Fig. 12. Schematic diagram of study area 10

Study Area 11

Area 11 is a small section of a drainage gorge which faces easterly. The top of this slope is dissected by the fence of the western boundary of the property. There is a second fence on the southern end of the area which runs in an east-west direction. The area is 70 feet long with a vertical drop of 30 feet at a grade of 40 degrees. There is one trail cutting a contour across half of the slope which is sufficient for walking with no branches obstructing the right of way.

The overstory is dense and dominated by oak (Quercus alba, Q. borealis, Q. macrocarpa) and walnut (Juglans nigra). There are also a few hickory (Carya ovata) and basswood (Tilia americana). The understory has some hophornbeam (Ostrya virginiana) located on the southern end of the area with many small oak and maple seedlings dotting the remainder of the slope. Undercover and litter is thick and does not seem disturbed by excess water from neighboring property.

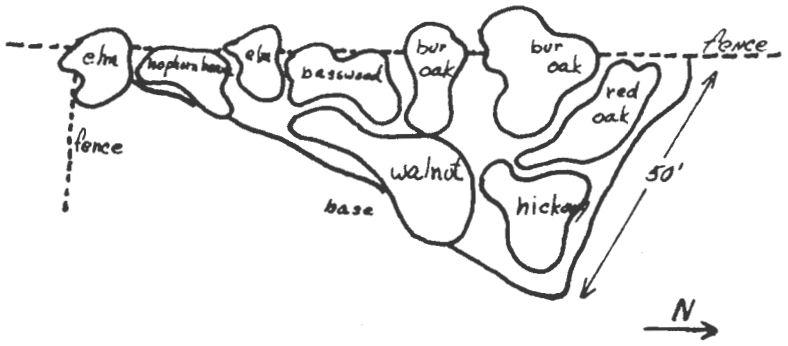



Fig. 13. Schematic diagram of study are 11

Study Area 12

The west property line transects this area which extends easterly toward Richardson's Branch. Its location may be noted on Fig. 121. The slope is approximately 160 feet long with a vertical drop of 60 feet. Its face is somewhat curved facing north on one end and westerly on the other.

Vegetation is very open, giving evidence that the slope has been grazed. The undercover is undeveloped over most of the slope, being thicker in the open area. The understory is

also undeveloped, except for small hophornbeam (Ostrya virginiana) and elm (Ulmus americana). Overstory dominance is held by oak (Quercus alba, Q. borealis, Q. macrocarpa) and hickory (Carya ovata, C. glabra). Maple (Acer nigrum), basswood (Tilia americana), hackberry (Celtis occidentalis) and elm (Ulmus americana) also appear here in smaller quantities.

The base of the slope has been eroded by the action of water flowing from neighboring property. There is also an accumulation of litter near the base which has been washed down from higher elevations.

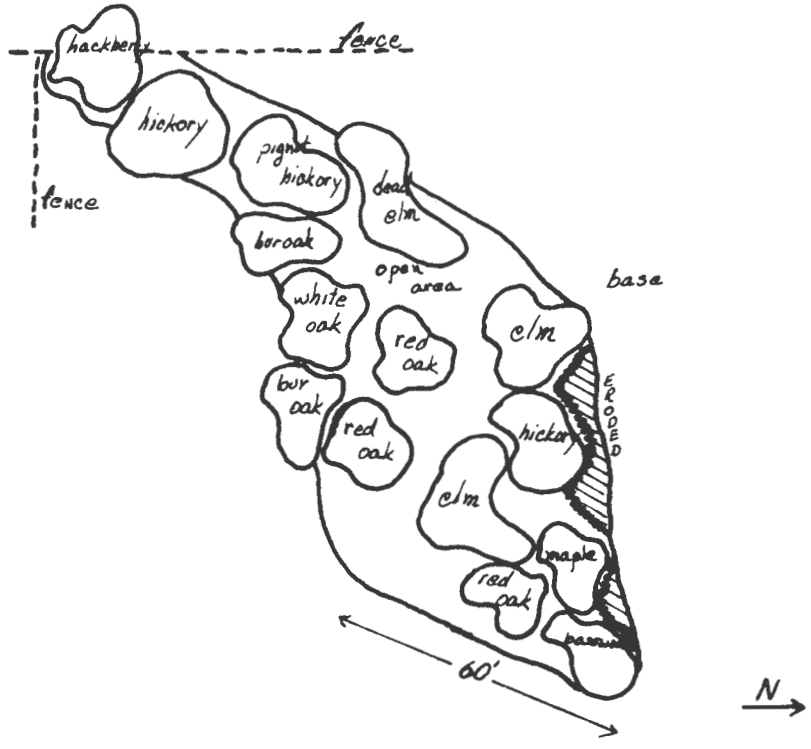



Fig. 14. Schematic diagram of study area 12

Study Area 13

Area 13 is a small slope facing east and is covered with a heavy canopy of red oak (Quercus borealis), hickory

(Carya ovata, C. glabra) and black maple (Acer nigrum). There is no understory with a thick undercover, except for a small eroded section near the base.

The slope is only 40 feet long and 60 feet deep. The face is steep at 60 degrees and has no trails or contours for walking.

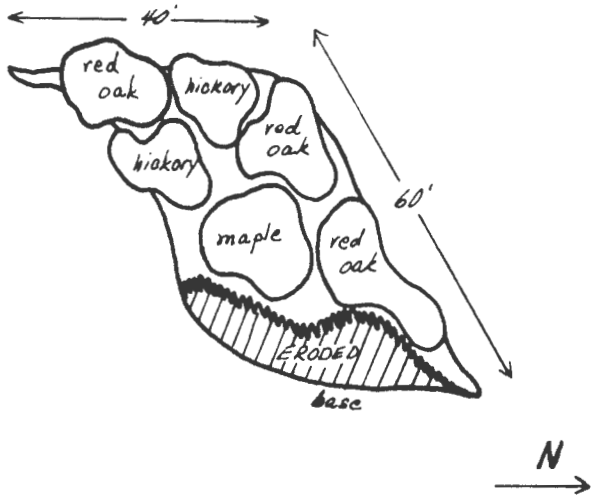



Fig. 15. Schematic diagram of study area 13

Study Area 14

This area is a large slope making up half of a secondary drainage gorge. The area is 150 feet long and 110 feet deep at its highest point. The face of the area is steep, but its intersection with Area 15 produces a gentle drop down half of its length. Undercover vegetation is sparse, but the litter produced by the canopy leaves a thick mat across the surface. The understory is also undeveloped, except for the hophornbeam (Ostrya virginiana) which is grouped on open areas of the slope. There are few seedlings of

overstory trees found in lower strata. Maple seems to be the only species regenerating. The overstory is dominated by oak (Quercus borealis, Q. alba, Q. macrocarpa), maple (Acer nigrum) and hickory (Carya ovata, C. glabra). Basswood (Tilia americana) and elm (Ulmus americana) are also found here.

The western end of this area includes a long washed area which extends 30 feet from the top edge of the slope. There is no erosion on the slope, and its base is not disturbed by the creek which flows by.

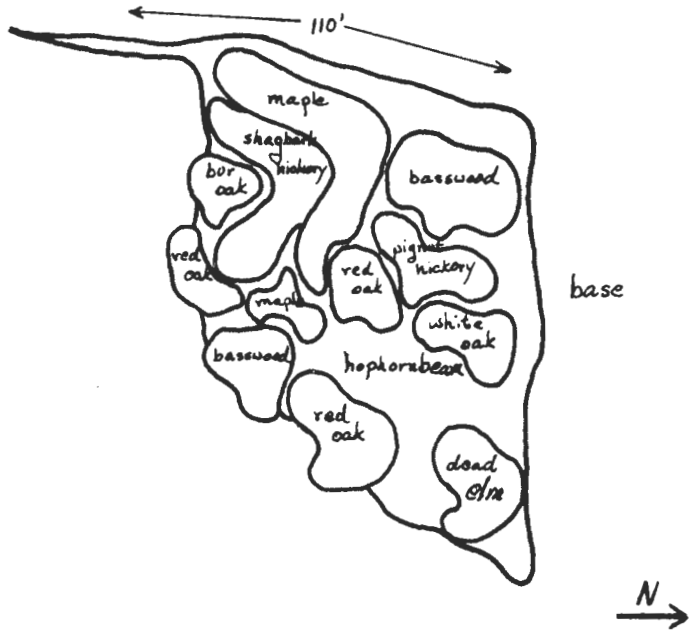



Fig. 16. Schematic diagram of study area 14

Study Area 15

Area 15 borders Richardson's Branch as indicated on Fig. 121. The area consists of a large slope 220 feet long and 110 feet deep. There is an approximate 70-degree drop.

Vegetation seems to be concentrated on the upper half of the slope, leaving the base and portions of the northern edge open. The slope faces an east-northeast direction as it turns to its intersection with Area 14.

The overstory is dominated by oak (Quercus borealis, Q. macrocarpa) and black maple (Acer nigrum). Other species in fewer numbers are basswood (Tilia americana), cottonwood (Populus deltoides) and shagbark hickory (Carya ovata). There is also a small population of elm (Ulmus americana), many of which have died. The understory is thick with hop-hornbeam (Ostrya virginiana) and includes a few maple and oak seedlings. The undercover is sparse but the litter is thick and holds the slope well.

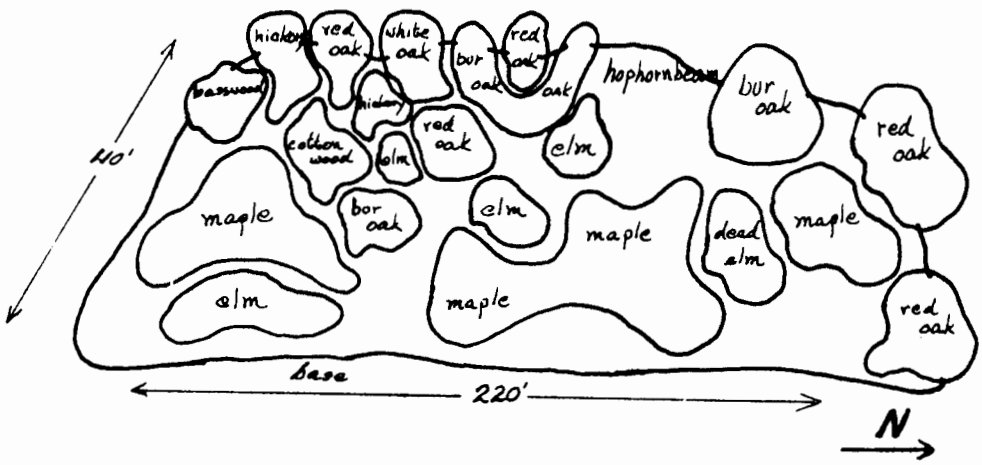



Fig. 17. Schematic diagram of study area 15

Study Area 16

This area is one wall of a secondary drainage gorge. The slope faces the south and extends 140 feet. Its depth

ranges from a shallow beginning to a depth of 110 feet where it intersects with Area 15. The drop is at 70 degrees, making it difficult to walk on. The base is eroded in two areas - one large area at its center and another at its deepest end.

The overstory has a dense canopy on the eastern end of the slope, becoming sparse toward the west. The dominants are oak (Quercus alba, Q. borealis), maple (Acer nigrum) and shagbark hickory (Carya ovata). Basswood (Tilia americana), elm (Ulmus americana) and pignut hickory (Carya glabra) are present in limited numbers. There is no understory, except for an occasional hophornbeam (Ostrya virginiana) or small elm. The undercover is sparse and litter has been washed to the base of the slope.

Study Area 17

This area is part of a gorge leading to Richardson's Branch. The face of this slope is exposed to the north. The area is 110 feet long and 100 feet deep where it reaches out to the floodplain as shown on Fig. 121. The face is steep with a drop of 80 degrees on the upper half of the slope to 100 degrees at the base where erosion has eaten and is still eating into the slope.

The dominant species in the overstory are maple (Acer nigrum) and basswood (Tilia americana) with hickory (Carya ovata, C. glabra), and oak (Quercus,alba, Q. borealis, Q.

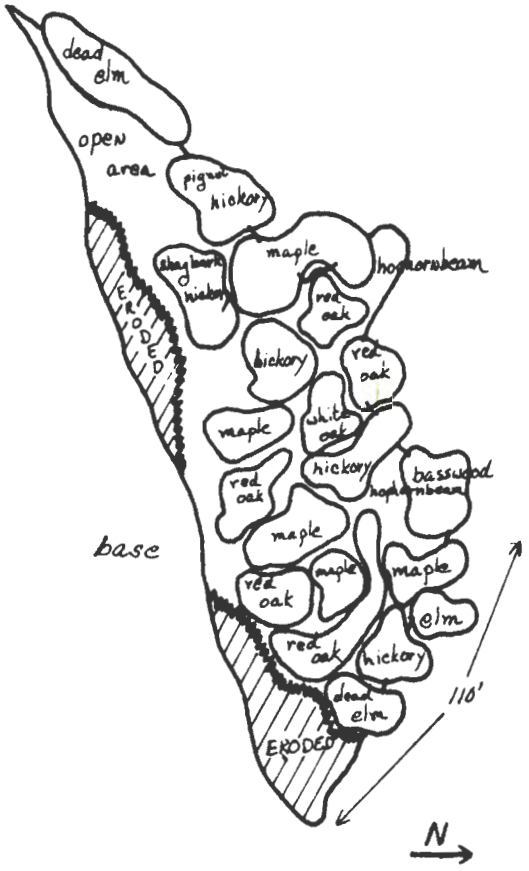



Fig. 18. Schematic diagram of study area 16

macrocarpa) scattered throughout the community. The understory is undeveloped, except for a hophornbeam and elm complex (Ostrya virginiana - Ulmus americana) growing on the slope's eastern end. The undercover and litter are absent, except for patches near the top rim of the slope.

Study Area 18

Area 18 as shown on Fig. 121 is an area next to Richardson's Branch. The slope is approximately 90 feet deep and and has a length of 120 feet. Its face is exposed to the

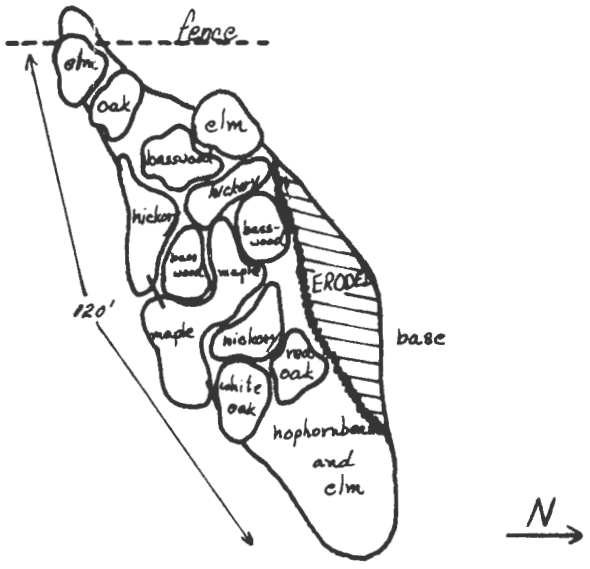



Fig. 19. Schematic diagram of study area 17

east and the floodplain of Richardson's Branch. There is no erosion on the surface which has a slope of 50 degrees.

The vegetation on the slope is concentrated on the top half of the slope and is dominated by maple (Acer nigrum), hickory (Carya glabra, C. ovata) and oak (Quercus alba). Honey locust (Gleditsia triacanthos), elm (Ulmus americana) and basswood (Tilia americana) are also present in the canopy. The understory is best developed near the base where hophornbeam (Ostrya virginiana) and honey locust entirely cover the area. The undercover is undisturbed and well developed, allowing much litter to hold in place as excess water moves down the surface.

Study Area 19

This area extends from Richardson's Branch in a westerly direction for 120 feet where its shallow end reaches its

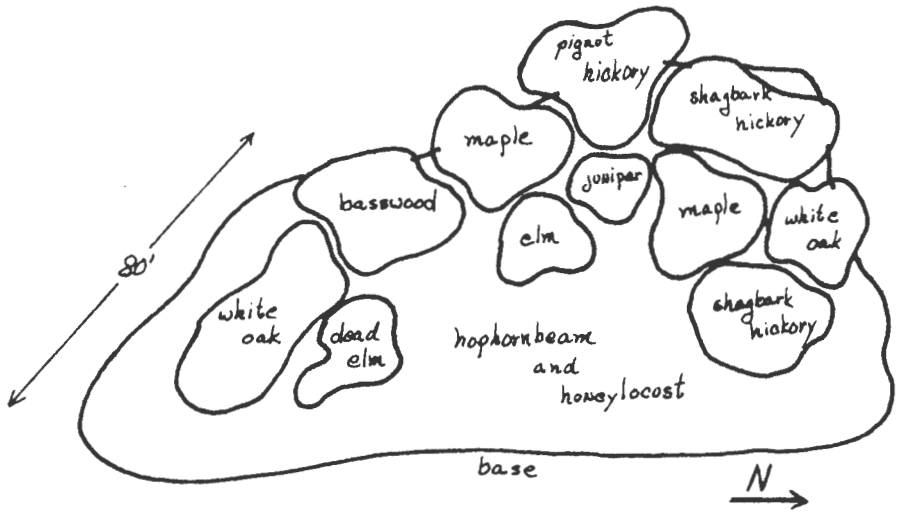



Fig. 20. Schematic diagram of study area 18

highest elevation. The area consists of sloping ground exposed in a southerly direction. There are signs of extensive logging on this slope, and the overstory has not yet recovered. Overstory trees are limited in number, and open areas are prevalent on all sections of the slope.

The overstory has only four species present: bur oak (Quercus macrocarpa), white oak (Quercus alba), honey locust (Gleditsia triacanthos) and shagbark hickory (Carya ovata). The understory in open areas consists entirely of hophornbeam (Ostrya virginiana) and is undeveloped under the existing canopy. Ground cover is developed but not diversified.

The slope reaches down 80 feet at its deepest point and has a 60-degree drop down its face.

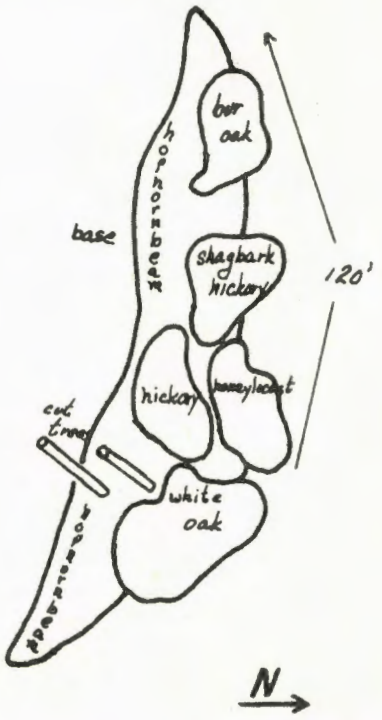



Fig. 21. Schematic diagram of study area 19

Study Area 20

There is a large opening between Area 19 and Area 20. This open expanse is part of Richardson's floodplain. The slope of Area 20 rolls into the floodplain area from the west. This may be located on Fig. 121. Area 20 is approximately 100 feet long and has a vertical drop of 70 feet at its deepest point. The surface slopes 40 degrees, which makes it easy to walk as compared to other slopes in the vicinity.

The overstory has been disturbed by logging and reduced to only ten trees. These are dominanted by black maple (Acer nigrum) with bur oak (Quercus macrocarpa), elm (Ulmus americana) and black walnut (Juglans nigra), producing

the remaining canopy. The understory of honey locust (Gleditsia triacanthos) is well developed on the lower slope which has been completely cleared of overstory trees. The undercover is mainly grasses which have dominated since the area was last grazed.

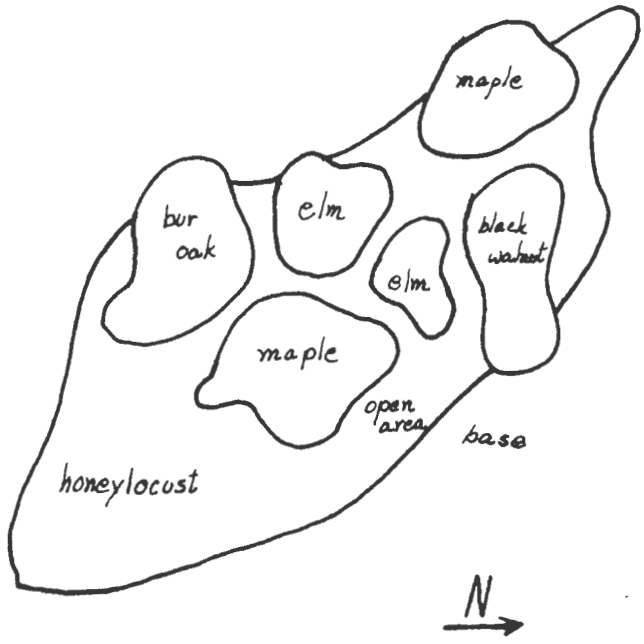



Fig. 22. Schematic diagram of study area 20

Study Area 21

Area 21 is part of a gorge which extends from Richardson's Branch to the road which enters the 4-H Camp. Fig. 121 shows its location in relation to the other areas. The slope is approximately 600 feet long and ranges in depth from 8 to 110 feet. The vertical drop is 90 feet with a slope of 50 degrees.

The overstory is made up of large trees evenly spaced and apparently open grown. The dominant species are oak and

hickory. The oaks (Quercus alba, Q. macrocarpa, Q. borealis) seem to be distributed across the top half of the slope with maple (Acer nigrum) and basswood (Tilia americana) covering the lower half. Hickory (Carya ovata, C. glabra), ash (Fraxinus pennsylvanica lanceolata) and elm (Ulmus americana) also grow here in fewer numbers. The understory includes hop-hornbeam (Ostrya virginiana), elm, hackberry (Celtis occidentalis) and hickory (Carya spp.). The undercover is well developed on the shallow end of the gorge, becoming sparse as the slope travels east.

The only erosion is along the fence which bisects the gorge in a north-south direction. The upper half of the slope is easier to walk than the lower portion.

Study Area 22

Area 22 may be found on Fig. 121. It extends from the road entering the 4-H Camp to the floodplain of Richardson's Branch. The slope is approximately 600 feet long and reaches down 110 feet at its deepest point. The base of the slope is eroded over half the slope's length. Summit regions are cut by smaller gorges which have been stabilized by vegetation. The grade on this slope is steep at 70 degrees. There are some areas which reach grades of 90 degrees near the eroded base.

The overstory is dominated by oak (Quercus alba, Q. borealis, Q. macrocarpa), maple (Acer nigrum) and basswood (Tilia

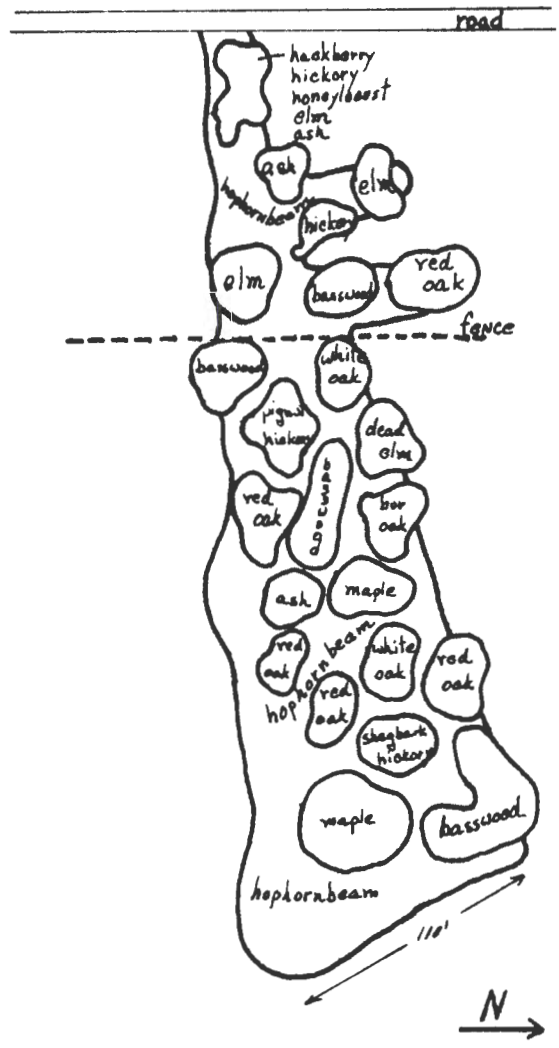



Fig. 23. Schematic diagram of study area 21

americana). The oak seems to dominate the top of the slope with maple and basswood dominating the middle and base areas. Other species included in the canopy are willow (Salix nigra), hackberry (Celtis occidentalis), cottonwood (Populus deltoides), elm (Ulmus americana), ash (Fraxinus pennsylvanica

lanceolata) and shagbark hickory (Carya ovata). The understory consists of hophornbeam (Ostrya virginiana) and elm Ulmus americana). There is some hickory and basswood mixed in this understory on the western end of the slope. The undercover is sparse, except in open areas where the canopy has been removed by loggers or by the death of the elm.

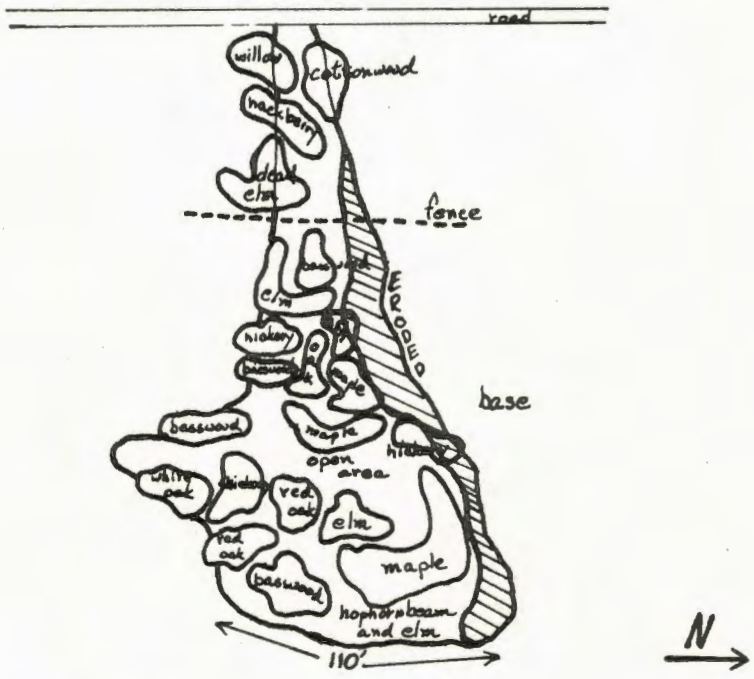



Fig. 24. Schematic diagram of study area 22

Study Area 23

Area 23 is located next to the floodplain of Richardson's Branch, and its exact location is listed on Fig. 121. The area consists of a slope approximately 250 feet long and 100 feet deep. The slope's surface is disturbed by a small gorge which erodes its center and a community of elms which have died, leaving the base without a canopy. There is a

gentle grade at the southern end of the slope where it intersects with Area 24. This grade may be used as a footpath down the slope.

The canopy is dominated by basswood (Tilia americana) and oak (Quercus macrocarpa, Q. borealis) with other species, hackberry (Celtis occidentalis), black maple (Acer nigrum) and hickory (Carya glabra) filling in the remaining canopy. Overstory is thick near the top of the slope, becoming less dense as it reaches the floodplain. The understory is undiversified with hophornbeam (Ostrya virginiana) being the only species present. This should change as species move in to take the place of elm. The undercover is more diversified, and many species of the canopy can be found here. Maple seems to be prevalent in the undercover, indicating that some changes might be made in regard to the dominant species. The undercover at the top of the slope is sparse, since it must compete with the water running over it for survival. Water has eroded a series of steps on the northern end of the slope which might be used as a trail in the future.

Study Area 24

This region may be found on Map 1 which shows its location. The area is of sloping nature, half of which has been eroded. The portion of the slope which is eroded has no vegetation, since the soil is too loose and disturbed to support its growth. The half which does support vegetation is

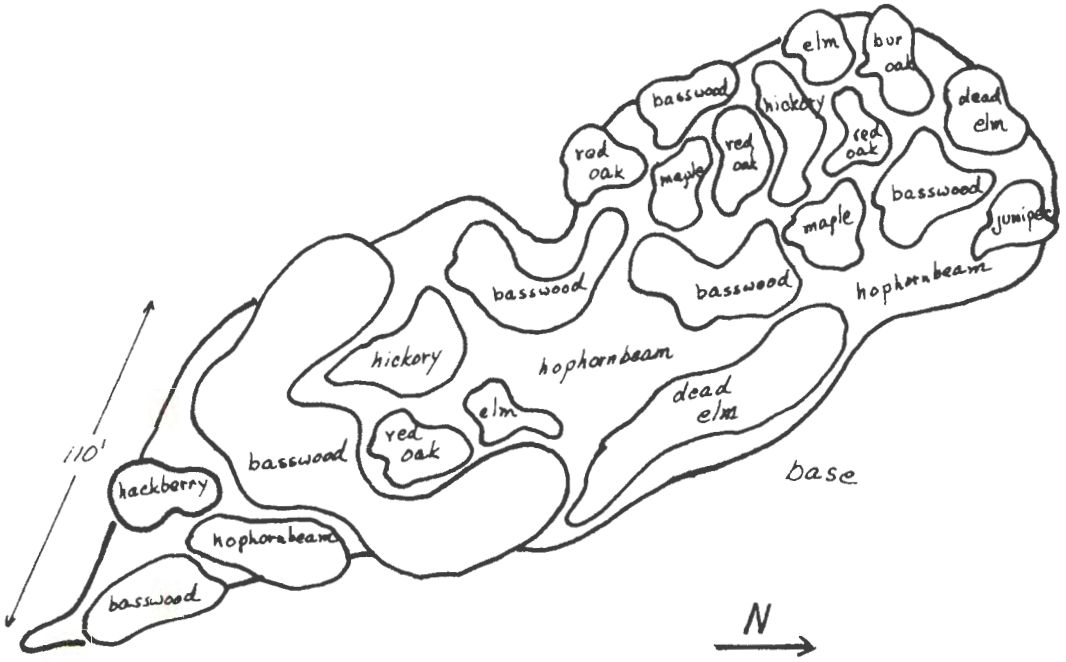



Fig. 25. Schematic diagram of study area 23

dominated by maple (Acer nigrum) and oak (Quercus alba, Q. macrocarpa, Q. borealis) and hickory (Carya ovata), elm (Ulmus americana) and Juniper (Juniperus virginiana) are found in fewer numbers. There is no understory which gives the slope an appearance of having been grazed in the past. The undercover is well developed and seedlings of the overstory are beginning to grow.

The slope is approximately 150 feet long and 100 feet deep. There is a 50-degree drop, except for the eroded part on which it approaches 90 degrees. A trail line has been cut down the vegetated portion of the area which is excellent for walking. There are no obstacles, since it has a high clearance.

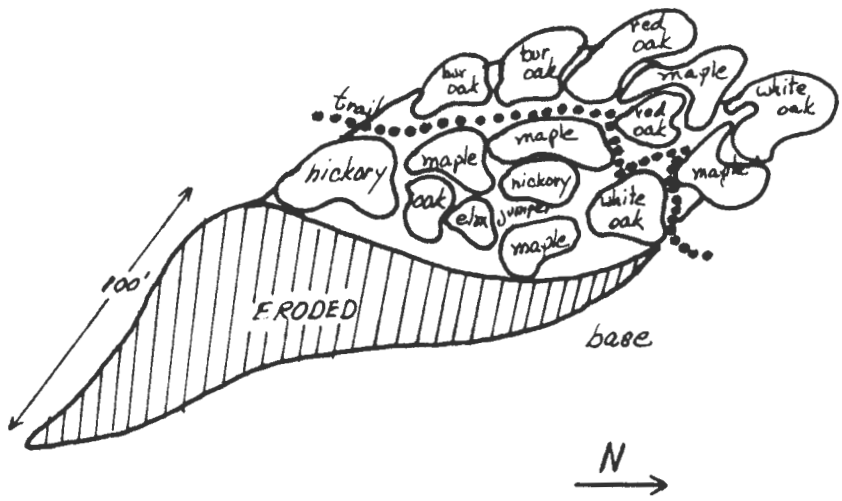



Fig. 26. Schematic diagram of study area 24

Study Area 25

Area 25 is exposed to the south and extends into a secondary drainage gorge. It consists of a sloping terrain with a length of 220 feet and a depth of 130 feet near its eastern end. The base of the slope has been eroded by the water which drains through the gorge.

The dominant species in the overstory are oak (Quercus alba, Q. macrocarpa, Q. borealis, Q. muhlenbergi) and hickory (Carya glabra), C. ovata). Basswood (Tilia americana), maple (Acer nigrum), walnut (Juglans nigra) and elm (Ulmus americana) are also found here. The lower portions of the slope are open with no overstory and little understory vegetation. Understory and undercover are poorly developed. The steepness of the grade and the absence of protection from water moving down the slope has prevented the development of these layers.

The slope could not be used for trails, since the surface is unstable and lacks vegetation.

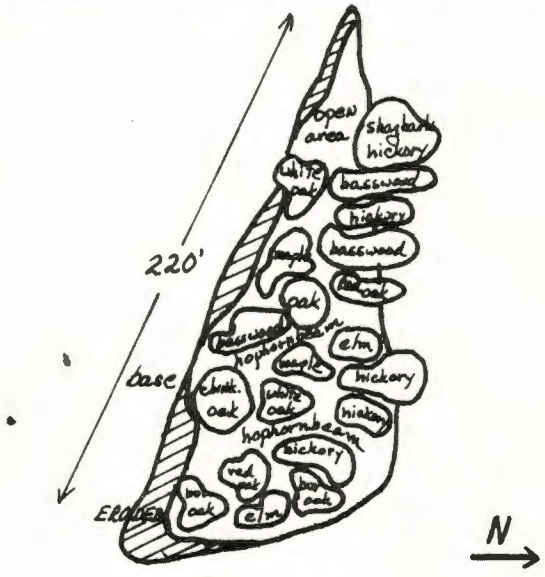



Fig. 27. Schematic diagram of study area 25

Study Area 26

This area is heavily populated with hophornbeam (Ostrya virginiana), which in some places are too dense to walk through. The slope is facing a northerly direction with a slight curve to the east at its deepest end. Exact location of this area may be found on Fig. 121.

The overstory is dominated by basswood (Tilia americana) and maple (Acer nigrum) with a few hickory (Carya glabra, C. ovata), elm (Ulmus americana), honey locust (Gleditsia triacanthos) and oak (Quercus borealis, Q. muhlenbergi). Overstory species are concentrated on two areas of the slope, leaving the open areas for a dense grove of understory hophornbeam. The undercover is not heavy, but the abundance of

litter is evident. Heavy leaf production of the vegetation above accumulates on the slope's face each fall.

The base of the slope is eroded. At one point, the eroded face is stabilized by hophornbeam, cottonwood, elm and other seedlings. A deer trail runs half the length of the slope through the thick grove of hophornbeam. At one place, a limb of red oak reduces the overhead to three feet. This also indicates that some trees on this slope were open-grown.

The area involved here has a length of 200 feet and a depth of 110 feet. The slope is steep at 60 degrees, except for the contour trail which bisects its face.

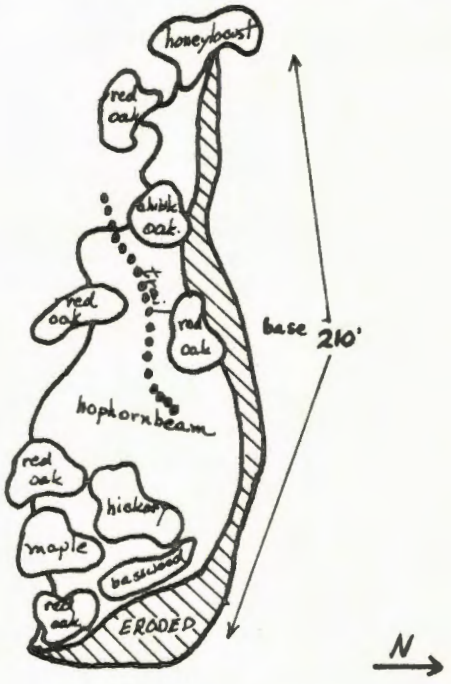



Fig. 28. Schematic diagram of study area 26

Study Area 27

The area is exposed to the south and is part of a drainage system flowing into Richardson's Branch. The slope turns north at the point where it reaches Richardson's floodplain. This area is 300 feet long and 100 feet deep with a slope of 80 degrees. There are no trails on the heavily populated slope, and erosion is minimal. Erosion does exist, however, at its base where water flow has washed away vegetation on its route to the creek.

Ash (Fraxinus pennsylvanica lanceolata), honey locust (Gleditsia triacanthos), elm (Ulmus americana), hickory (Carya ovata, C. glabra), oak (Quercus alba, Q. muhlenbergi, Q. borealis, Q. macrocarpa) and basswood (Tilia americana) are all represented in the overstory which is dominated by oak and hickory. The canopy reduces the light to 20 percent at ground level, except for a few areas where dead elm and oak have reduced the canopy. The understory is well developed with hophornbeam, hickory and maple. These are most prevalent on open areas of the slope. Ground cover is undisturbed and maintains a medium amount of litter.

This slope includes some of the largest shagbark hickory in the area. These seem to have grown at a time when the slope was more open, since the branching habit is low and open. The largest of these appear on the top rim of the slope, indicating there may have been some advantage for light absorption.

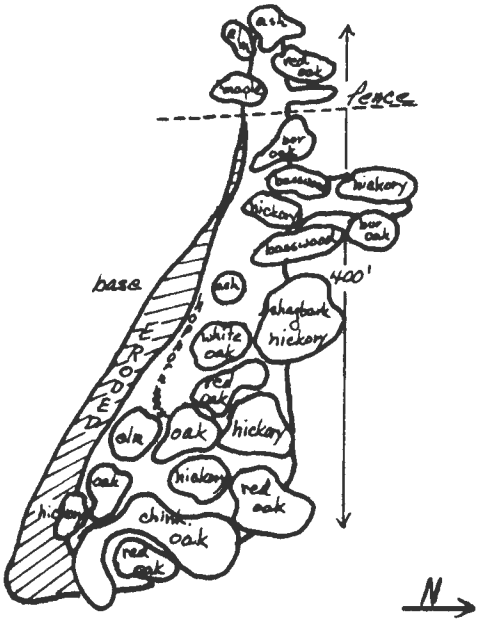



Fig. 29. Schematic diagram of study area 27

Study Area 28

This slope is part of a secondary gorge which drains a western section of the arboretum property and can be located on Fig. 121. The area is 450 feet long and 120 feet deep with an average slope of 80 degrees. There is extensive erosion along the base of the slope and a large slide on its eastern end. Center slope exposes the remains of a group of elms which have died and fallen.

The slope faces north and has a canopy dominated by basswood (Tilia americana) and hickory (Carya ovata, C. glabra). Oak (Quercus alba, Q. borealis), maple (Acer nigrum), green ash (Fraxinus pennsylvanica lanceolata), cottonwood (Populus deltoides), honey locust (Gleditsia triacanthos) and elm (Ulmus americana) are also found in limited

numbers. Understory species are dominated by hophornbeam (Ostrya virginiana), which is extremely thick near the western end of the slope. It has established on parts of the eroded surface with elm, maple, oak, hophornbeam and juniper. Vegetation changes are indicated by the maple which,on areas of the slope, is becoming the dominant understory species.

Undercover has limited diversification especially where areas have been exposed to more light by the removal of the canopy. Litter is washed down the slope and accumulates at its base. All of these factors indicate how disturbed this area is.

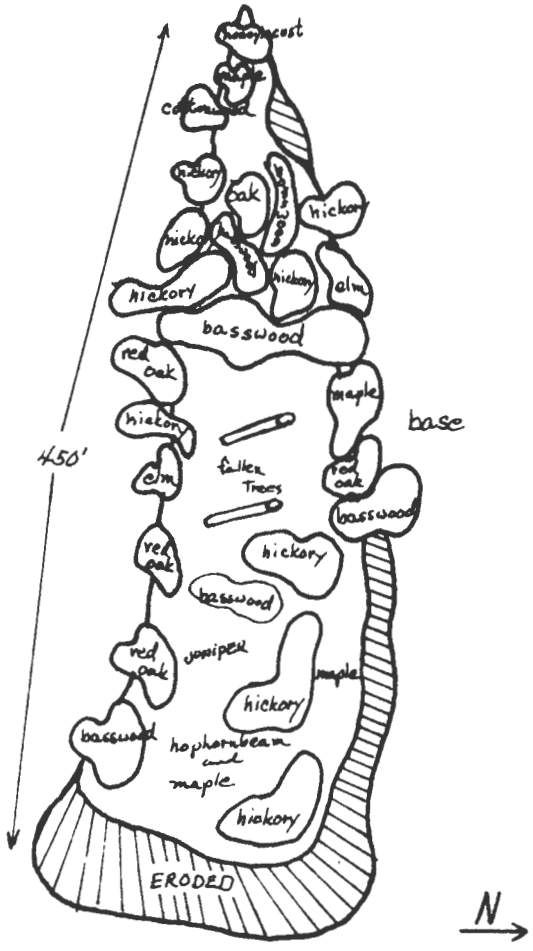



Fig. 30. Schematic diagram of study area 28

Study Area 29

This portion of the property is part of a peninsula connecting two drainage gorges. Its face is completely eroded and exposed to the east. The plant population is limited to elm (Ulmus americana) and hophornbeam (Ostrya virginiana), the only species represented on the slope. The slope measures 110 feet long and 100 feet deep. Its face continues to erode with each rain.

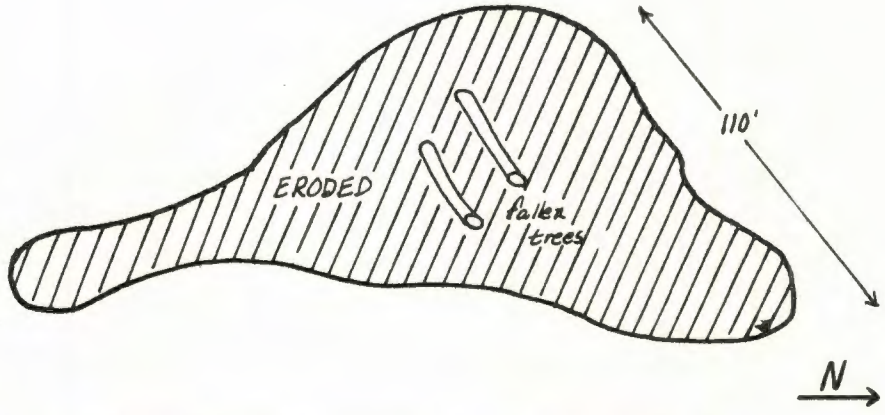



Fig. 31. Schematic diagram of study area 29

Study Area 30

Area 30 is a long section of sloping ground which can be located on Fig. 121. Dimensions are 450 feet by 100 feet with a slope averaging 60 degrees. Large portions of the slope are exposed to the south with the eastern end curving to the north, exposing its face to the east.

Overstory canopy covers 85 percent of the slope and is dominated by oak (Quercus alba, Q. borealis, Q. macrocarpa,

Q. muhlenbergi) and hickory (Carya ovata, C. glabra). Walnut (Juglans nigra), maple (Acer nigrum), honey locust (Gleditsia triacanthos), hackberry (Celtis occidentalis), basswood (Tilia americana), and elm (Ulmus americana) are also part of the community. The understory is dominated by hophornbeam (Ostrya virginiana) with other species slowly moving into this strata. Undercover is sparse, since the canopy reduces the light to 20 percent. Litter holds the slope and is quite thick, since production by the canopy is heavy.

There are two trails on the surface which follow the contours of the slope. The trails extend from summit to base and are excellent for walking.

Study Area 31

This area is part of a small gorge, extending in a westerly direction. The slope faces the north with an exposure shaded by Area 30. The eastern end of the area is open with a steep slope of 80-90 degrees. One ridge of this section is on a gentle grade of 30 degrees. Center slope is populated at its upper level but open from mid-slope down. Its western end opens into a bowl-shaped cavity, which is disturbed by erosion and fallen trees.

Overstory species are dominated by maple (Acer nigrum) and basswood (Tilia americana) with butternut (Juglans cinera) supporting the canopy. Understory is sparse


Fig. 32. Schematic diagram of study area 30

developed only on the eastern end of the slope. Elm (Ulmus americana) and hophornbeam (Ostrya virginiana) are found in equal numbers, populating this strata.

Undercover is well developed, covering the entire slope and holding the litter well. There has been a build up of litter at the base, producing a deep organic layer. The only disturbed area is located near the western end of the gorge.

Area 31 is 100 feet long and at its deepest point is 130 feet. Grade varies from 60 degrees across mid-face to 90 degrees at the lower base. Its location may be found on Map 1.

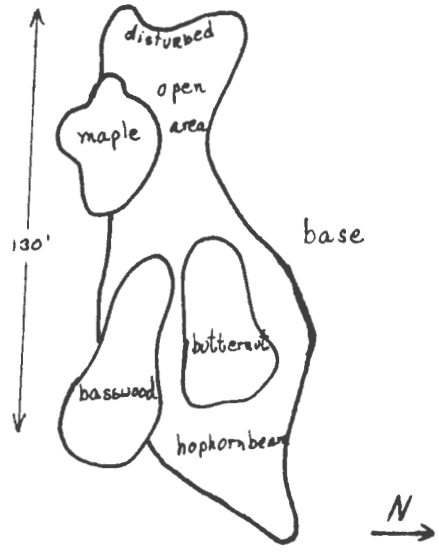



Fig. 33. Schematic diagram of study area 31

Study Area 32

A gorge extends from Area 31 in a southerly direction. Area 32 follows this gorge and provides its western boundary.

A diagram of this area can be found on Map 1 and Fig. 34. Its dimensions are approximately 450 feet long with a depth varying from 80 to 130 feet. The top edge of the slope is cut by many smaller gorges extending 10 to 20 feet over its top rim. These gorges make the upper edge uneven, creating washed areas down the face of the slope. The base of this area is relatively straight, tapering down to its intersection with the creek. Percent drop down the face varies from 60 to 80, depending on where the small gorges have channeled a steeper grade.

The southern quarter of this southeast-facing slope is densely populated with overstory trees. Distribution decreases on the second quarter of the slope and on the northern end. There is one area near center slope where the population regains its density. Species are distributed homogeneously throughout the population, except for slight groupings of shagbark hickory (Carya ovata) and bur oak (Quercus macrocarpa) near the top rim.

Canopy dominance is by oak (Quercus alba, Q. macrocarpa, Q. muhlenbergi, Q. borealis) with maple (Acer nigrum), hickory (Carya cordiformis, C. ovata), box elder (Acer negundo), basswood (Tilia americana), butternut (Juglans cinerea) and elm (Ulmus americana) evenly distributed throughout. Most of these trees are very old, and a few near the base reach 100 feet into the canopy.

The understory is dominated by hophornbeam (Ostrya virginiana). Hickory, honey locust, sumac, juniper, maple, elm, basswood and oak are also found but not in great numbers. Understory is best developed in areas of past disturbance where the battle for dominance has already begun. Upper elevations have thicker understory communities than other portions.

The undercover varies across the slope, being most diversified in undisturbed areas and tallest in open areas. Branches and logs litter the face of the slope. In one area, the logs form "V"-shaped positions which reduce the speed of runoff water and accumulate litter. Litter is very thick on undisturbed surfaces of the slope and absent in areas where water has washed it to the base.

Study Area 33

The region designated as Area 33 is a short section of sloping ground, facing south. The section is 150 feet long and 80 feet deep with a slope of 70 degrees toward the top and 90 degrees at the base.

The overstory species are grouped on both ends of the slope, leaving an opening in the center. Trees have fallen and the remains are evident at this point. Overstory canopy is dominated by oak (Quercus borealis, Q. alba, Q. macrocarpa) with maple (Acer nigrum) and basswood (Tilia americana)


Fig. 34. Schematic diagram of study area 32

with maple (Acer nigrum) and basswood (Tilia americana) adding a small percentage of the total. Understory includes oak, maple, basswood and a large amount of hophornbeam (Ostrya virginiana). These species are also found in the undercover along with hickory and elm. The undercover is thick and covers the ground well. Open areas are littered with trunks and branches of dead trees blown over by the wind. Cover has managed to hold litter in place, making a thick mulch over the surface of the slope.

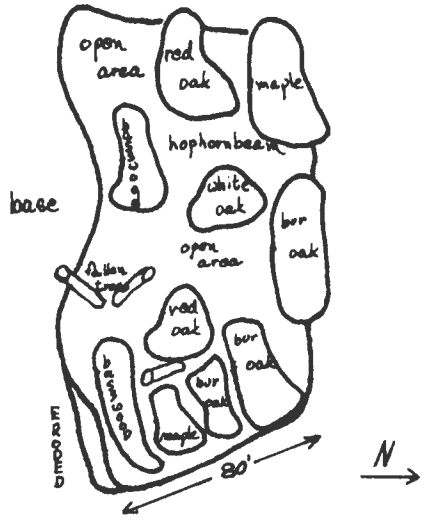



Fig. 35. Schematic diagram of study area 33

Study Area 34

The drainage gorge, which is the location of this sloping area, travels in a southerly direction to the main stream. Its surface is exposed to the west, 130 feet long and reaches down 80 feet at its deepest point. Slope ranges from 50-70 degrees and is steepest near its shallow end. The shallow end continues for 40 feet into a ditch covered at

one end in basswood and honey locust (Tilia americana and Gleditsia triacanthos). Vegetation and surface have been disturbed by water and wind. Many fallen trees have opened the entire canopy. The existing overstory follows the top rim, which hangs down over lower portions.

Species in the overstory are bur oak (Quercus macrocarpa), basswood (Tilia americana) and maple (Acer nigrum). Oak and basswood dominate. Maple, hickory, hophornbeam, and basswood are found in the understory. Hophornbeam (Ostrya virginiana) dominates in the open areas which make up 60 percent of the surface. Many areas are absent of overstory or understory trees. The undercover is littered with hollow trunks and branches that completely cover the ground near center slope. Elm, hophornbeam, maple and hickory are found in the undercover in greater numbers than is common for the vicinity.

The area will be classified as a disturbed oak-basswood community. A long trail runs across the face of the slope. It is obstructed by fallen trees and is difficult to walk.

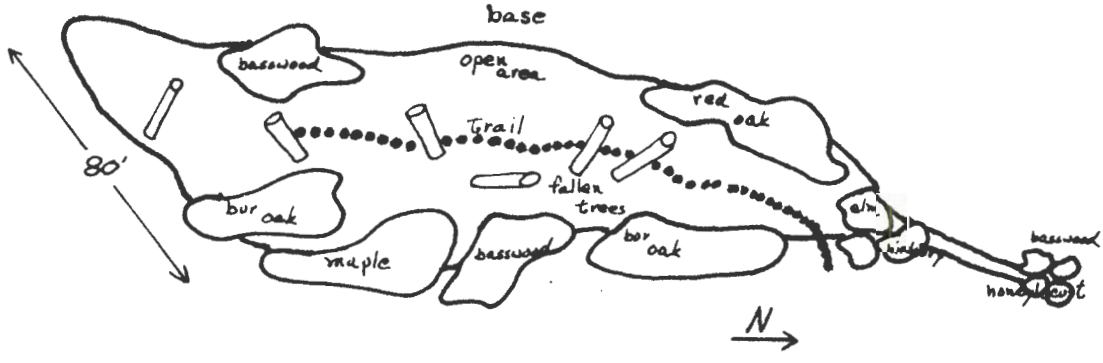



Fig. 36. Schematic diagram of study area 34

Study Area 35

The wall of this slope turns into a secondary drainage system which continues north for 125 feet. Area 35 is 60 feet at its deepest point and faces due east with a slope ranging from 70-90 degrees.

Overstory is dense near the top of the slope and sparse at the base. Species included are black maple (Acer nigrum), basswood (Tilia americana), red oak (Quercus borealis), hickory (Carya glabra), red cedar (Juniperus virginiana) and honey locust (Gleditsia triacanthos). Dominants in the overstory are maple and basswood. Light reaching the floor is reduced 70 percent by the canopy, except for an open space at center base where there are no obstructions.

Understory is dominated by hophornbeam (Ostrya virginiana) with hickory, basswood and maple sparsely scattered throughout. Undercover is heavy near the top and sparse at the base with deep accumulations of litter. Branches and trunks are strewn at all levels, causing pockets of organic material to build up as they stop litter moving down the slope.

The shallow end of the gorge has been used in past years as a dump, leaving tin and wood covering the area and preventing growth of any vegetation.

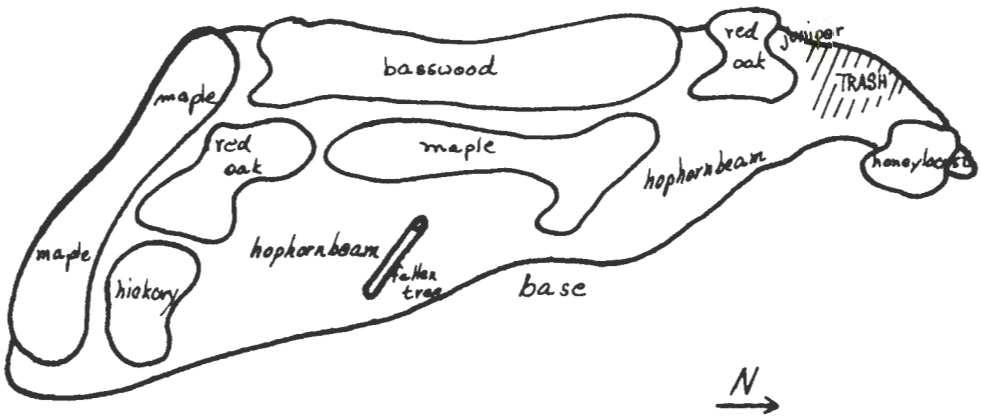



Fig. 37. Schematic diagram of study area 35

Study Area 36

This area is located next to the road entering the 4-H Camp. It is similar to its neighbor, (Area 37), because the disturbance caused by the road has affected them to the same degree. Excess water from the roadbed washes its base and western end, preventing the establishment of any plant species. Wind has uprooted trees, leaving trunks scattered across its surface.

The slope travels in an easterly direction and faces due south. Its surface is approximately 60 feet deep and 70 feet long. Steepness varies from 50-70 degrees and is steepest near the base.

Overstory is sparse with a variety of species present. The white oak (Quercus alba), red oak (Quercus borealis), bur oak (Quercus macrocarpa) and shagbark hickory (Carya ovata) dominate the western end of the slope with black maple (Acer nigrum) and ash (Fraxinus pennsylvanica lanceolata)

dominating the eastern edge. Center slope is open, except for one hickory (Carya glabra), which is weakly rooted and likely to fall in the near future.

Understory consists entirely of hophornbeam (Ostrya virginiana), and it, like the overstory, is sparse and scattered. Undercover is not well developed even with the great amount of light reaching the slope. This situation is created by the erosive waters washing soil down the surface. Litter has accumulated at the base, leaving higher levels bare with branches and trunks littering the floor at all levels. Seedlings of hickory, oak and maple are found in the undercover and may provide some stabilization of the surface.

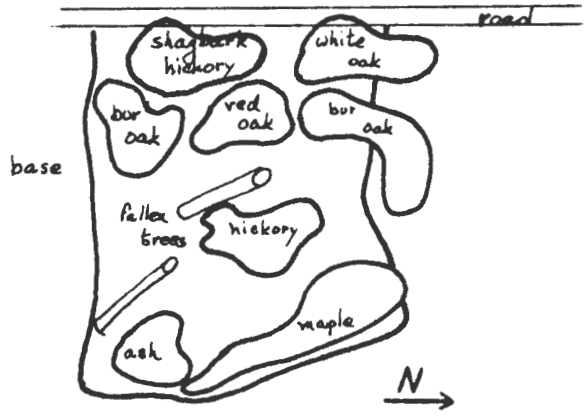



Fig. 38. Schematic diagram of study area 36

Study Area 37

Area 37 is located next to the road leading to the 4-H Camp entrance. It is very steep with a slope of 60 degrees, greater in places where disturbances have caused washouts. The slope faces due north, running from the road in an easterly direction for approximately 100 feet. It is approximately

70 feet from top to bottom ending in a small creek and becoming deeper toward the east where the creek cuts a sharp channel.

At the base of this slope is a cement culvert which connects this gorge with a small portion on the other side of the road. There is also a great deposit of roadfill sliding down the bank of the road into the stream below.

Species found here and on a margin area at the top are bur oak (Quercus macrocarpa), red oak (Quercus borealis), elm (Ulmus americana), serviceberry (Amelanchier canadensis), basswood (Tilia americana), black maple (Acer nigrum), pignut hickory (Carya glabra), eastern hophornbeam (Ostrya virginiana) and red cedar (Juniperus virginiana).

Basswood (Tilia americana) dominates the top of the area but is not found on lower regions. There are two large, fallen basswood, one midway down the slope and the other at the base. Both seem to have fallen as a result of poor anchorage on the steep grade.

Black maple (Acer nigrum) dominates the lower slope with trees ranging in size from three feet in the understory to 70 feet overhead. Center slope is relatively open with a few medium-sized ash (Fraxinus pennsylvanica lanceolata) and hophornbeam (Ostrya virginiana). The fallen basswood have destroyed everything else. There is a strong understory of black maple, ash, elm (Ulmus americana) pignut hickory

(Carya glabra) and hophornbeam. The undercover is spotty and heavier at the base than at the top. Surfaces are eroded with diagonal trails and drainage washouts. Most of the litter has been washed from the top of the slope, leaving bare ground over many areas.

Disturbances are the result of many factors. The road to the west causes an unusually heavy runoff into the stream below. Old cattle trails have since been channeled by water down the slope, resulting in uncontrolled erosion. Fallen basswood have destroyed many smaller understory trees, leaving large trunks and branches scattered across the middle of the area.

Vegetation is dominated by basswood (Tilia americana) and black maple (Acer nigrum) in segregated communities at the top and base of the slopes.

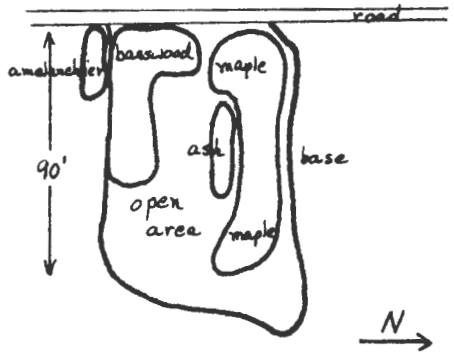



Fig. 39. Schematic diagram of study area 37

Study Area 38

Continuing east, this area is a large crescent-shaped slope facing north with an approximate drop of 70 degrees.

The slope is marked to the west by a group of large red oaks (Quercus borealis) and a few smaller basswood (Tilia americana). It continues for about 150 feet, where it is marked by a large pignut hickory (Carya glabra) which has been topped by lightning.

There are no overstory trees below a margin at the very top of the slope. This area is ringed by an overstory of red oak (Quercus borealis) and basswood (Tilia americana) with some black maple (Acer nigrum) at the base on each end of the slope. There are two large fallen trees - one from the top of the slope which apparently rolled down the slope crushing the other trees below and the other fell from the opposite slope cutting down everything in its path. This disturbance was probably recent, since the understory has not grown to any extent. There are a few hophornbeam (Ostrya virginiana) which apparently escaped destruction.

Surfaces are littered with large trunks and limbs, making it impossible to walk across this area. Some places along the top of the slope have been washed clean by waters from above.

There are few trees in the understory, except for a sparse group of elm (Ulmus americana) and basswood (Tilia americana). The other species present in this community include red oak, hophornbeam and pignut hickory.

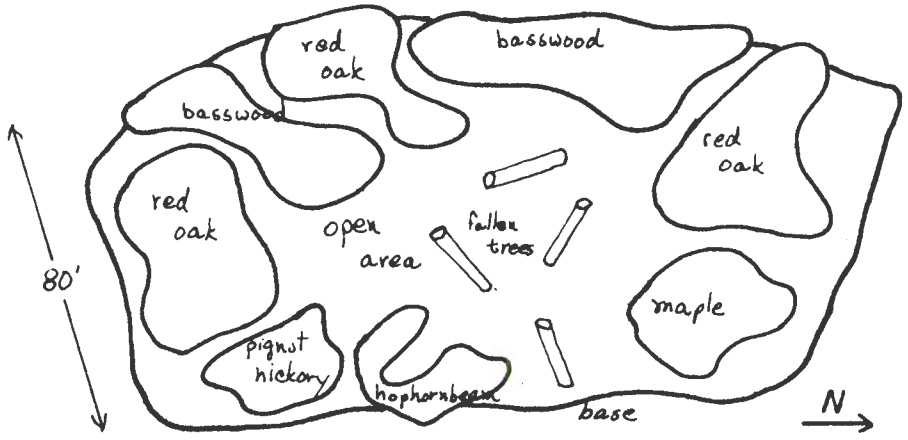



Fig. 40. Schematic diagram of study area 38

Study Area 39

Area 39 continues in an easterly direction but is somewhat straighter than Area 38. Exposure is due north and is much steeper than its neighbor. It continues from the topped hickory to a large multi-trunked basswood (Tilia americana) growing on a gradual incline at the end of the slope to the east where its direction changes.

This area has a dense plant population. The groundcover is more diversified here even though the overstory and understory are dense. This population was probably undisturbed by the cattle which once grazed here because of the steepness of slope.

The top of the slope is marked by bur oak (Quercus macrocarpa) and hickory (Carya glabra) but black maple (Acer nigrum) seems to dominate the interior of the area. Other species present are elm (Ulmus americana), hophornbeam (Ostrya virginiana), basswood (Tilia americana) and one

medium-sized hackberry (Celtis occidentalis ) at center slope.

The understory is almost entirely black maple, except for a few elm, basswood and hophornbeam. Litter on the floor is deep even though the slope is steep. Undercover produces and holds litter.

Area 39 is about 100 feet long and 100 feet deep. At the lower end, there is a 90-degree drop for 10 feet down to the creek. Above this, the slope is less severe at 75 degrees.

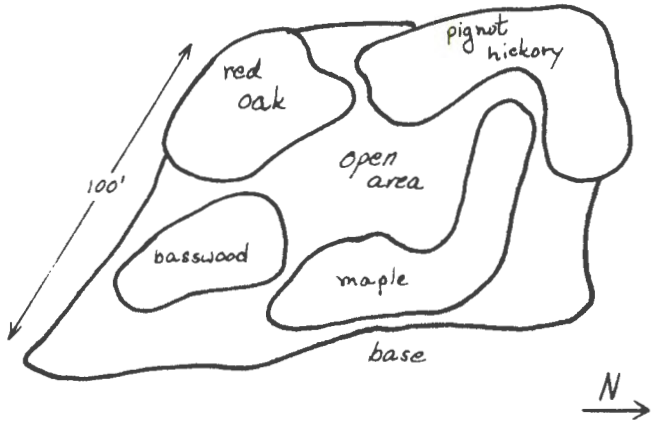



Fig. 41. Schematic diagram of study area 39

Study Area 40

From this point, the slope turns to the south. Area 40 faces due east at this point with a marked difference in vegetation. It measures about 230 feet long becoming thinner at its southern end where it reaches the top of the gorge. This slope and the one opposite it are part of a secondary system feeding into the major creek. The slope is a 70-degree

drop to mid-slope where it decreases to 50 degrees.

Vegetation consists largely of hickory (Carya glabra) and basswood (Tilia americana) at the top with elm (Ulmus americana) and hophornbeam (Ostrya virginiana) through the mid-section. Its southern end is market by a large black maple (Acer nigrum) but none were recognized on the slope itself.

There is little groundcover, but the soil under this area is very deep and humic. It is very easy to sink four or five inches, walking over the area. In some areas, there are corncobs carried onto the slope by animals from adjoining fields. The slope is also strewn with small limbs and branches from larger trees at the top of the slope.

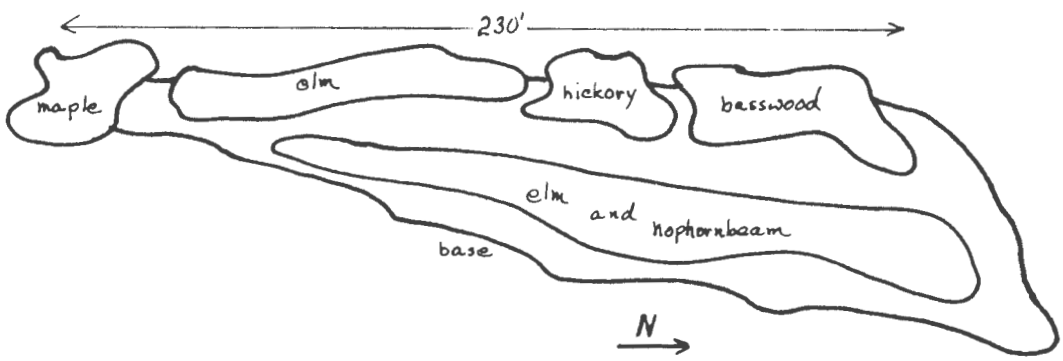



Fig. 42. Schematic diagram of study area 40

Study Area 41

As part of this secondary system, Area 41 begins on level ground and slopes down to the stream. It is exposed to the west and is quite different from its neighbor, Area 40.

A dense population of basswood (Tilia americana) and black maple (Acer nigrum) are found at top slope and hickory, both pignut and shagbark (Carya ovata, C. glabra) on mid-slope. The understory is well defined with basswood, hickory and a few ash (Fraxinus pennsylvanica lanceolata). Undercover is very thick, and, for the first time, ferns appear. Litter holds to the slope, because there seems to be little runoff to wash it down.

From the end of the gorge looking north, one can see two types of communities as a result of the slope's exposure. The east-facing slope is almost barren of undercover, and this soil, although deep, is very bare. The westerly exposure is very green, fairly uniform, with a greater number of species persent and with a more defined understory.

This area is approximately 200 feet long and 120 feet deep at its highest point. The end of the slope to the north is marked by two large trees fallen lengthwise up the slope.

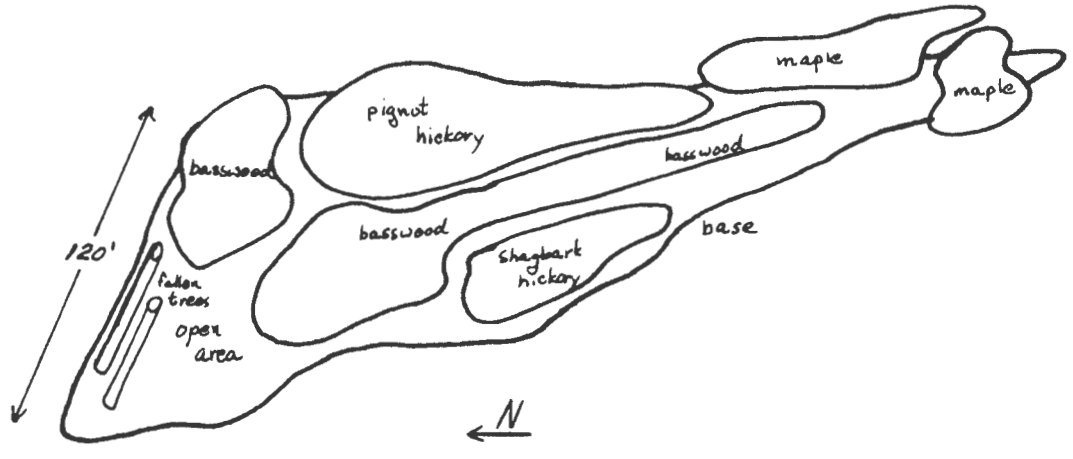



Fig. 43. Schematic diagram of study area 41

Study Area 42

Area 42 is north of the fallen trees and continues in a northeasterly direction but begins to curve slightly both east and west as it moves down to the stream. Beyond the fallen trees, the vegetation becomes more open with large trees at the top of the slope shading the entire area.

Basswood is the largest tree on the slope, and, at the top of the slope, there is a large cottonwood (Populus deltoides). Eastern hophornbeam (Ostrya virginiana) is scattered over the slope and dominates the understory.

The slope continues for about 120 feet and is about 100 feet from top to bottom. At the lower edge there is a 20-foot drop at 90 degrees, which has been washed out by the creek. This also caused a large tree to fall at one end of the slope. The understory is not thick but manages to keep the runoff from washing soil from the surface. There are no trails on this slope which are so common on the others, probably because of the steepness of the surface.

There is a very interesting black maple (Acer nigrum) on the center of the slope which is shaped like a Japanese bon sai, curving over the creek in one direction and down to the ground in another.

The only obvious disturbances here have been caused by runoff rushing down the steep incline by the creek, eating away at the base of the slope washing soil and plant material with it.

Basswood (Tilia americana) and black maple dominate the slope. Most of the community is located at the top and along the edges. The center of the slope is open with small eastern hophornbeam growing over its surface.

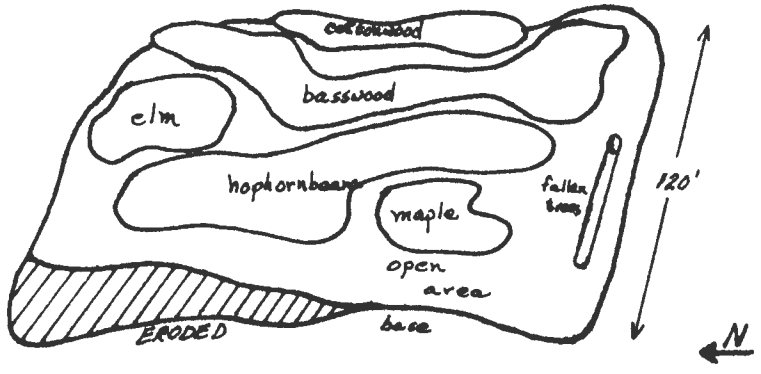



Fig. 44. Schematic diagram of study area 42

Study Area 43

The slope of Area 43 continues in a northeasterly direction for 120 feet, with small curving gorges near the top. At one point near the stream, a tree has fallen from the other side making a bridge from one slope to the other. The slope is very steep with an 80-degree drop from top to bottom and a depth of 110 feet.

The top portion of the slope is lined with basswood (Tilia americana) and black maple (Acer nigrum). On the lower edge there is a group of hickory (Carya glabra) and a large green ash (Fraxinus pennsylvanica lanceolata). Understory consists of hophornbeam (Ostrya virginiana) and black maple with a few hickory and basswood.

The undercover is sparse with little litter clinging to the surface. The ground here is very loose and easy to sink into. There are two trails which run on contours across the slope and have an accumulation of leaves and litter on their flat surfaces. There are some fallen branches too small to block movement across the slope.

The community on this slope is similar to other maple-basswood associations in the area, but the maple has slightly heavier proportions than usual.

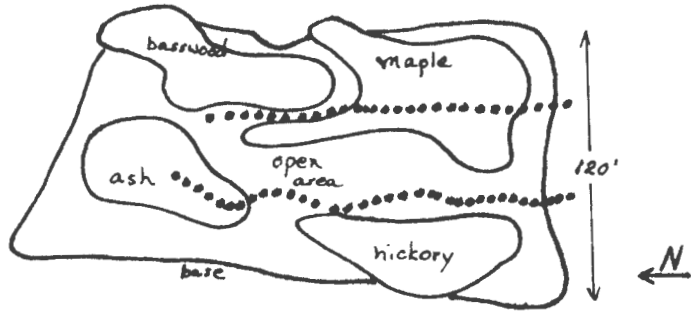



Fig. 45. Schematic diagram of study area 43

Study Area 44

Area 44 may be located on Map 1. This slope makes a large crescent shape and continues for some 300 feet. Slope here is not so steep, varying from a 20-degree drop at its top to 60 degrees at the lower edge. The distance down the slope is approximately 200 feet with open vegetation.

The area is lined with red oaks (Quercus borealis) at its top, one being very large and directly in the center of the slope. There are basswood (Tilia americana), black maple (Acer nigrum) and a few hickory (Carya glabra) below

this ring. Its base is open except for one 80-foot pignut hickory near the stream. Understory species are dominated by eastern hophornbeam.

Litter is thick but undercover is fairly sparse. At the base where it is more open, the undercover thickens.

At the base, a large red oak has recently fallen bringing with it three basswood and part of an ash. The tree must have fallen in the past three days, since my last visit to the area. The large opening caused by the fall will definitely cause changes in the undercover and understory.

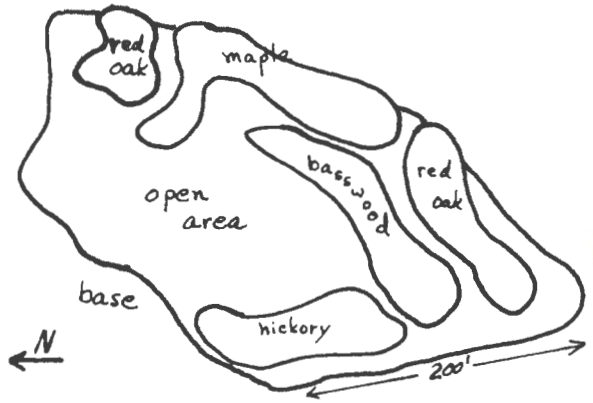



Fig. 46. Schematic diagram of study area 44

Study Area 45

This area turns easterly. It is about 300 feet long and 200 feet deep with a grade ranging from 70 degrees at the top to 100 at the base. The slope is lined at the top by small trees - eastern hophornbeam (Ostrya virginiana), basswood (Tilia americana), serviceberry (Amelanchier canadensis) and cottonwood (Populus deltoides). Basswood and red oak (Quercus borealis) dominate center slope with some black

maple (Acer nigrum) toward the base, with lower areas open and dropping to the stream below.

There is little litter on the slope and a very low undercover. Understory is mostly black maple, hophornbeam and some hickory (Carya glabra). A large serviceberry (Amelanchier canadensis) is shaded out by a red oak growing from one side of the slope.

On the eastern portion of the slope, the understory becomes much higher with larger hophornbeams and a deeper undercover.

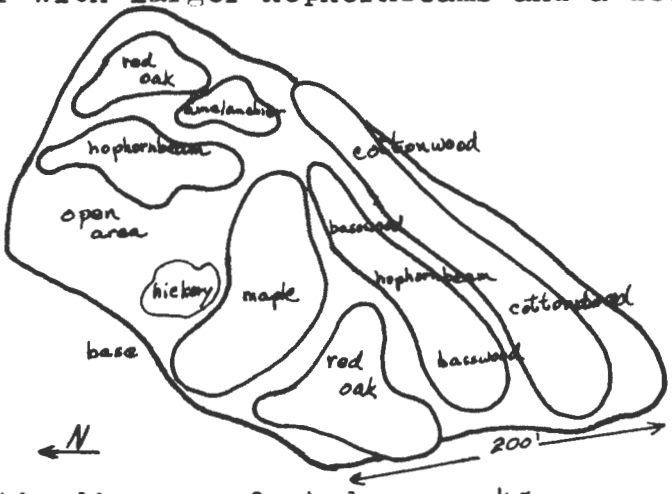



Fig. 47. Schematic diagram of study area 45

Study Area 46

This area continues in the same northeasterly direction. The slope here is much deeper from top to bottom. Maple (Acer nigrum) dominates the overstory at the top and red oak (Quercus borealis) dominates the lower area. A large multi-trunked basswood (Tilia americana) covers center slope and a few large hophornbeams grow toward the top. There are a few dead and dying elms on the eastern side of the slope.

Area 46 stretches 200 feet down to the stream with a 70-degree drop. There are many fallen limbs on the ground surrounded by a thick layer of litter. The slope ends to the east with a gentle slope, characteristic of slopes when their direction changes. This grade is a comfortable 20 degrees lined with hickory (Carya ovata) and bur oak (Quercus macrocarpa).

Other species found here in fewer numbers are ash (Fraxinus pennsylvanica lanceolata), elm (Ulmus americana), hickory (Carya glabra), and serviceberry (Amelanchier canadensis).

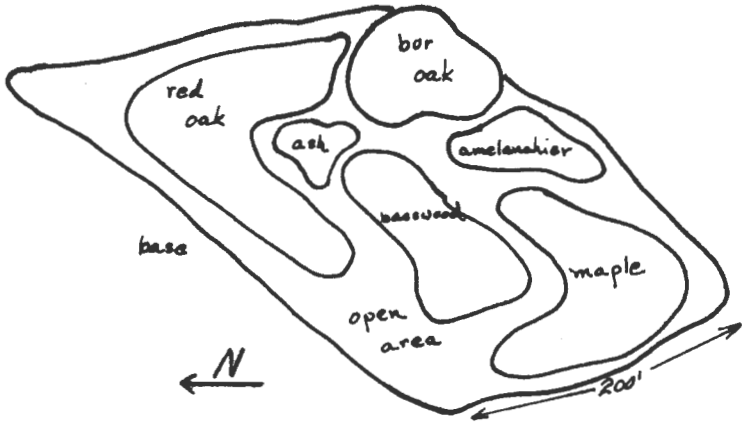



Fig. 48. Schematic diagram of study area 46

Study Area 47

This area takes a southerly course into another of the secondary gorges cut by the stream. The slope is steep with an 80-degree drop to a channel cut by water running down to the stream below. There are no signs of erosion on the surface and the undercover is quite heavy, although the canopy overhead reduces sunlight to 20 percent.

The lower slope is heavily populated with large pignut hickory (Carya glabra). Trees of all sizes are found here, ranging from seedlings in the undercover to the canopy. Next to the stream is a butternut (Juglans cinerea) standing above. Top slope is covered with red oak (Quercus borealis) and basswood (Tilia americana). Basswood and hophornbeam (Ostrya virginiana) make up the understory, which is sparsely scattered across the surface. Undercover is less disturbed here than on most areas, although there is a thinner cover toward the top of the slope.

The surfaces face due east and is approximately 200 feet long. At its deepest point, it stretches down 240 feet to the stream where a large bleached trunk of a dead elm stands as a monument at its base.

Trees are smaller toward the top but are very numerous. Larger trees include red oak (Quercus borealis) located halfway down the slope to the south.

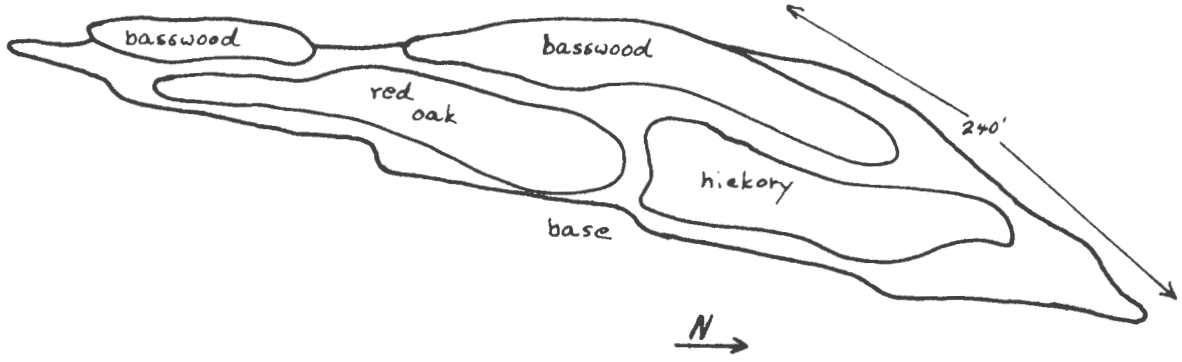



Fig. 49. Schematic diagram of study area 47

Study Area 48

Opposite the slope of Area 47, the surface continues in a northerly direction and faces due west. It is half of the secondary drainage system but quite different from its neighbor to the west. Basswood (Tilia americana) dominate the slope's summit and are found over the surface in all sizes. Red oak (Quercus borealis) and black maple (Acer nigrum) are randomly scattered across the slope but are not as numerous as basswood.

The surface has two grades, the top being a fairly gentle 30-degree slope, increasing to 70 degrees at the base. Understory is mostly hophornbeam (Ostrya virginiana) but many red oak and basswood seedlings appear here.

There are two cattle trails cut on its face which drop gently to the base near the stream. The longest of these trails is suitable for walking. This slope is more disturbed than its neighbor. Undercover is not as diversified with bare areas where the gravel base has been washed from under its soil cover.

Other woody species which occur on the slope are red cedar (Juniperus virginiana) and elm (Ulmus americana). There is a large, dying elm at the base of this slope next to the stream.

The base of the slope near the stream has been cut to a 100-degree drop by waters gushing down from higher levels. A terrace along Richardson's Branch begins at the base of the slope. Area 48 is very open compared to the slopes further away from the creek.

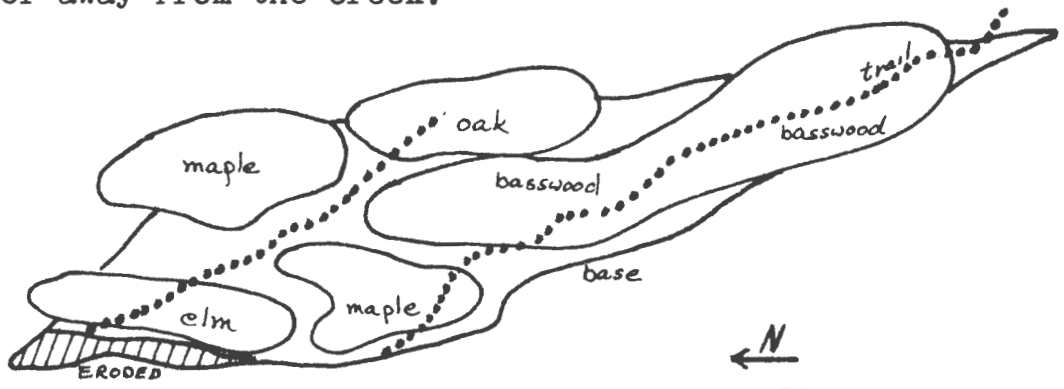



Fig. 50. Schematic diagram of study area 48

Study Area 49

Study Area 49 is the largest single community considered, since these observations began. This slope unlike the others is bordered at its base by a terrace above floodplain of Richardson's Branch and not an opposing slope. Its surface is approximately 800 feet long and is 300 feet deep in some places. The slope ranges from 50 to 80 degrees. The base of the slope is straight, running in a southeasterly direction. Its top is not straight but curves back and forth, forming small gorges into the summit. Its top continues more easterly than the base.

Population of the overstory is uniform from end to end, but the understory and undercover are not as homogeneous

being spotty and in segregated groups. The overstory is not grouped by species as was the case on most other slopes. Black maple (Acer nigrum), butternut (Juglans cinerea), black walnut (Juglans nigra), basswood (Tilia americana) and red oak (Quercus borealis) are all randomly scattered across its face. There seems to be no difference in the overstory plant communities due to elevation on the slope. This is not true of the understory which is much heavier at the top with a dense planting of hophornbeam (Ostrya virginiana) There is also a line of red cedar (Juniperus virginiana) located on the top edge, and, at one point, they are in a straight line as if they were planted for some purpose.

Undercover is just the opposite being thickest at the base and thinning to bare ground in some places near the top. Litter is thick at the base and sparse at higher elevations.

Trees have not fallen on this slope, which is common in the ravine areas. Large branches litter the ground, and only two elms have died on the eastern end of the area. Elms are still standing, but their death has increased the light reaching the floor on the surfaces beneath them. Canopy over the other portions of the slope reduce light to 20 percent and less on sections near the summit.

There are no severe erosion problems over the surface, but runoff has washed soil covering gravel deposits near mid-slope.

Four strands of barbwire are loosely stretched between two trees. These old remains mark the northern edge of a 40-acre section. There is only one trail running across the western half of the slope near center.

Vegetation is classified as an oak-basswood-maple community with a few hickory and walnut mixed randomly throughout the community.

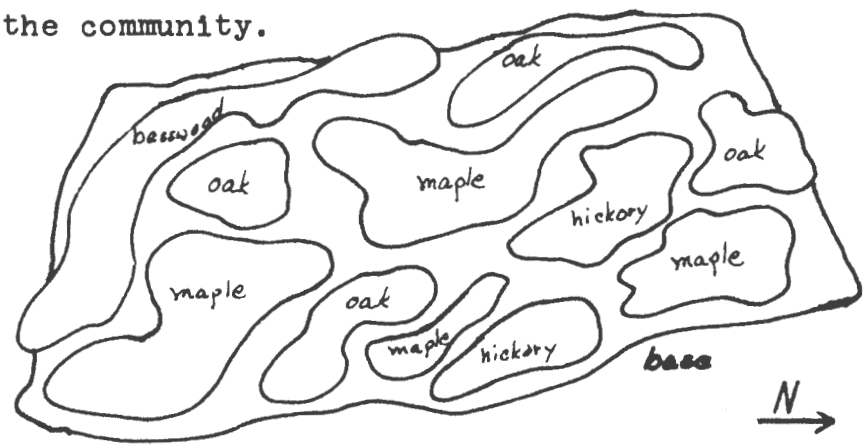



Fig. 51. Schematic diagram of study area 49

Study Area 50

On the southern side of a gentle grade to the base, the slope makes a southwest turn into another drainage gorge cut deep into the floor of the area. The slope has a large bowl-shaped top running to the south with a relatively straight base ending at a stream. Its surface is exposed to the east.

Vegetation consists of a heavily populated overstory and understory. A canopy of overstory trees reduces direct light reaching the floor to 10 percent, accounting for the sparse undercover on the surface. Dominant overstory trees

are the red oak (Quercus borealis), bur oak (Quercus macrocarpa) Chinkapin oak (Quercus muhlenbergi) appearing in equal numbers. Chinkapin and bur oaks are located toward the top with a few white oak (Quercus alba) lining the top edge. There is a large population of elm (Ulmus americana) on the lower portion with basswood (Tilia americana) randomly spotted on all sections of the area.

Understory is mostly elm and hophornbeam (Ostrya virginiana). There are some oak, but these are concentrated near the summit. It is very thick, except for one area at the base where water during wet seasons has washed its surface clean.

The undercover is sparse but the litter remains thick. A cover of leaves and small branches, acting as a mulch, keep the floor moist.

Slope is steep with an 80-degree drop from top to bottom. A heavy population of trees protects a large basal area, and water from above the slope is prevented from washing down the steep incline and eroding the soil. The area is approximately 200 feet long and 180 feet deep. At present, there are no large fallen trees on the face of the slope; however, the large population of elm at the base should change this observation in the future.

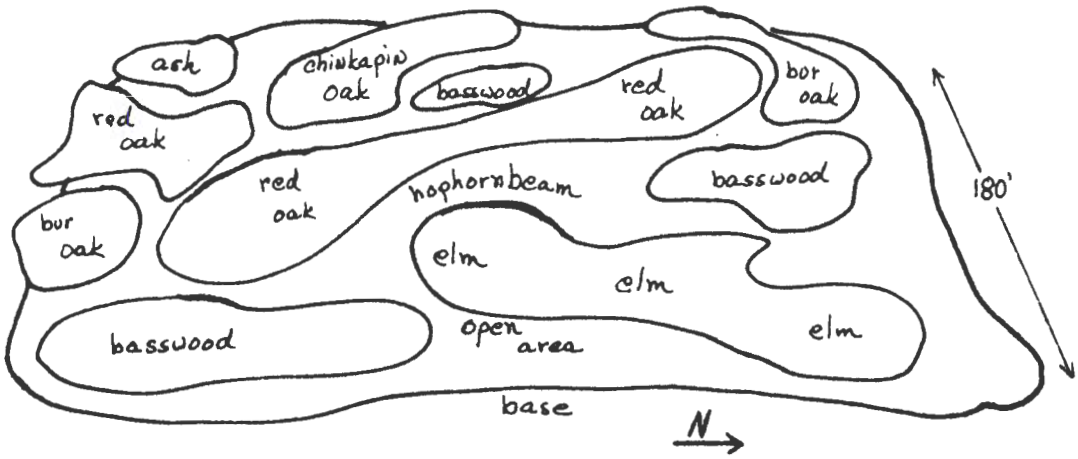



Fig. 52. Schematic diagram of study area 50

Study Area 51

The area turns north into a secondary drainage gorge whose face is exposed in a westerly direction. It continues north for 80 feet and reaches the top of the slope near medium-sized chinkapin oak (Quercus muhlenbergi). The overstory community is largely oak. There are red oak (Quercus borealis), bur oak (Quercus macrocarpa) and chinkapin oak with one basswood (Tilia americana) and a topped bitternut hickory (Carya cordiformis) near the top.

The understory dominates the lower slope which is mostly hophornbeam (Ostrya virginiana) and basswood. The undercover is thick compared to others in the area with a heavy litter becoming thicker as one proceeds down the slope. The undercover is diversified and does a good job in preventing erosion on the 60-degree drop. There are two large branches strewn across the slope but neither has destroyed any of the smaller trees on their flight to the floor.

The slope is definitely of oak classification, since the canopy is almost entirely Quercus species.

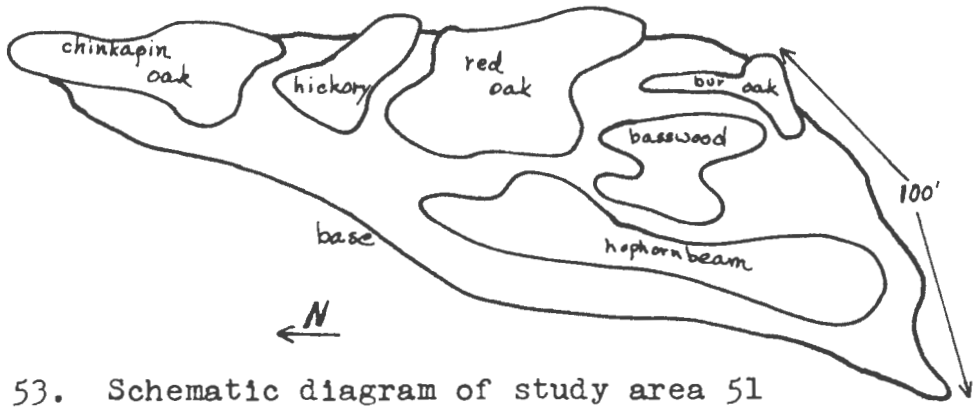



Fig. 53. Schematic diagram of study area 51

Study Area 52

The opposite half of this secondary drain turns back to a southerly direction but does not travel as far as its neighbor, Area 51. It only continues for 50 feet before reaching the primary gorge. The slope faces east with a drop of 80 degrees near the top to 90 degrees at its base.

The overstory population is not as dense as the opposite slope, since a large red oak has fallen at center slope from the upper edge and clears a large area. The remaining overstory trees are bur oaks (Quercus macrocarpa), chinkapin oaks (Q. muhlenbergi) and white oak (Q. alba) with a few bitternut hickory and live elm at the base. These trees are growing in a circular pattern around the open center.

The opening has stimulated the growth of the undercover, making it thicker and higher than most in the area. The

soil and litter is deep, held in place by the the thick growth.

The tree trunks and branches make the slope difficult to walk across. There is also a large dying elm at the base of the slope, which is opening more area to additional light.

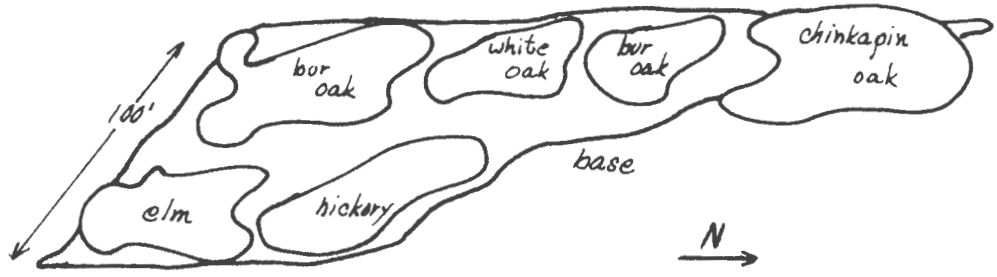



Fig. 54. Schematic diagram of study area 52

Study Area 53

The slope then turns into a secondary drainage gorge. The gorge is not deep and will be considered as one community. The top of the slope turns to the west for 20 feet and then back southeasterly to the primary gorge for 30 feet. This slope has also been opened by the falling of a large chinkapin oak (Quercus muhlenbergi). This tree has come to rest against another oak which supports it 20 feet above the floor.

The overstory is still dominated by oak. Chinkapin (Quercus muhlenbergi), bur (Q. macrocarpa) and red (Q. borealis) are all found here with a maple (Acer nigrum) and basswood (Tilia americana) near the top of the slope. At the base of the slope stand two dying elms (Ulmus americana) which have lost most of their leaves.

Understory is thick and dominated by hophornbeam (Ostrya virginiana). The other species in smaller quantities are shagbark hickory (Carya ovata) and black maple.

The slope is steep with an 80-degree drop, but little soil has been lost to erosion. The thick undercover has protected the soil and has helped hold the litter to the slope. Near the base of the slope the primary gorge has cut away part of the slope's face leaving a drop of 100 degrees.

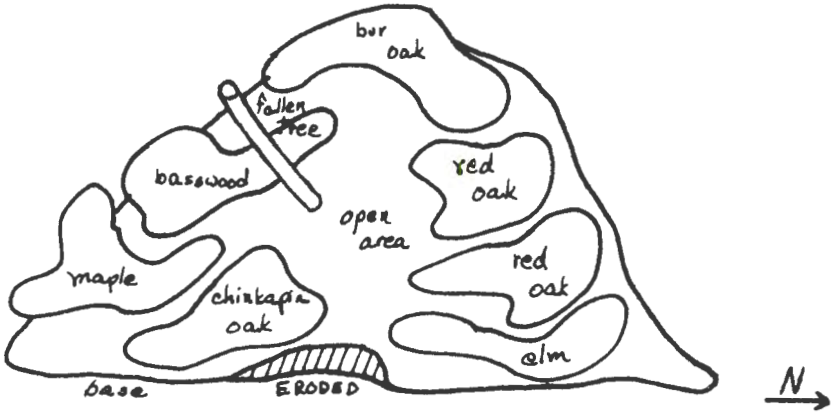



Fig. 55. Schematic diagram of study area 53

Study Area 54

The primary gorge turns to the southwest continuing for 300 feet before reaching its top elevation. The slope of Area 54 is cut by small lateral gorges which sink down to its base. At its deepest point, the slope runs down approximately 180 feet. The slope faces an east-southeast direction which varies with the surfaces cut by lateral gorges. There are no noticeable cattle trails on the slope which might be too steep for their use. The drop is near 50 degrees at the top increasing to 70 degrees at the base.

The vegetation on the slope is thick with large red oaks (Quercus borealis) dominating the overstory. Pignut and shagbark hickory (Carya glabra, C. ovata) are mixed in but are not as large or as numerous as the oak. Chinkapin oak (Quercus Muhlenbergi), bur oak (Q. macrocarpa), black maple (Acer nigrum) and basswood (Tilia americana) grow on the top ridge of the slope giving some diversity to the community.

The canopy reduces direct light reaching the floor to 20 percent. This may be the reason for the sparse understory of hophornbeam (Ostrya virginiana) with occasional intrusions of basswood and black maple. The understory is not consistent being thick in places near the top and absent or reduced on other regions.

The floor has been washed clean in some areas by run-off waters which still disturb the slope. Unwashed areas are sparsely covered by a groundcover which is young. There is virtually no litter on the slope, except near the base where it has built up deposits, washed from above.

There are fallen trees at the top rim of the gorge which block entrance from above. The slope will be classified as an oak-hickory association, since these two species dominate the canopy.

Study Area 55

This area turns in a northeast direction for approximately 280 feet. The community is segregated here with ash

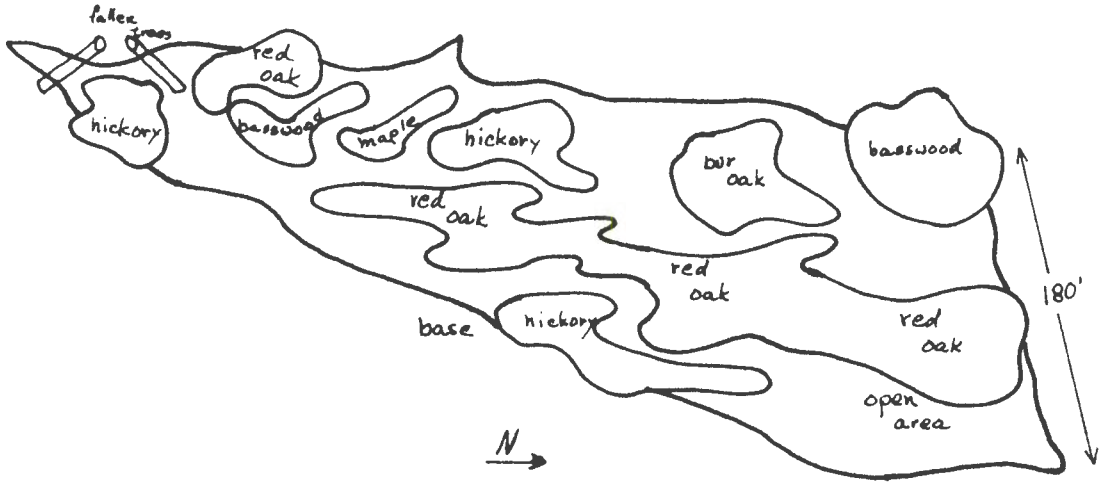



Fig. 56. Schematic diagram of study area 54

(Fraxinus americana) dominating the higher slope and maple-basswood dominating the deeper slope. The southern end of the slope is young and still changing. The undercover has not developed, so the ground is exposed and conducive to erosion. The lower slope is not as bare with a few annual species populating the undercover.

The understory is heterogeneous with eastern hophornbeam (Ostrya virginiana), black maple (Acer nigrum), basswood (Tilia americana) and hickory (Carya ovata) growing under a scrubby canopy. The understory is short, ranging from 6 to 8 feet, except for the hophornbeam whose height is 20 feet.

The shallow end of the slope is populated with white and green ash (Fraxinus americana, Fraxinus pennsylvanica lanceolata), having little understory and no undercover. As the slope becomes deeper and less disturbed, the overstory and understory trees become larger. In this area, a mixture

of maple (Acer nigrum), chinkapin oak (Quercus muhlenbergi), basswood and shagbark hickory grow in varying numbers. The basswood and maple dominate throughout this region.

The slope is deteriorating from run-off water and falling trees. The water has washed much of the litter down to the base of the slope, leaving the higher areas bare. The slope varies from an 80-degree drop in the upper region to a 50-degree drop to the north where the slope turns into another community. There are a few fallen trees in the shallow end of the gorge which are small but have created disturbance in the area.

The slope has two communities growing side by side on its face: the first is an ash-hickory; and the second is a maple basswood in the deeper sections.

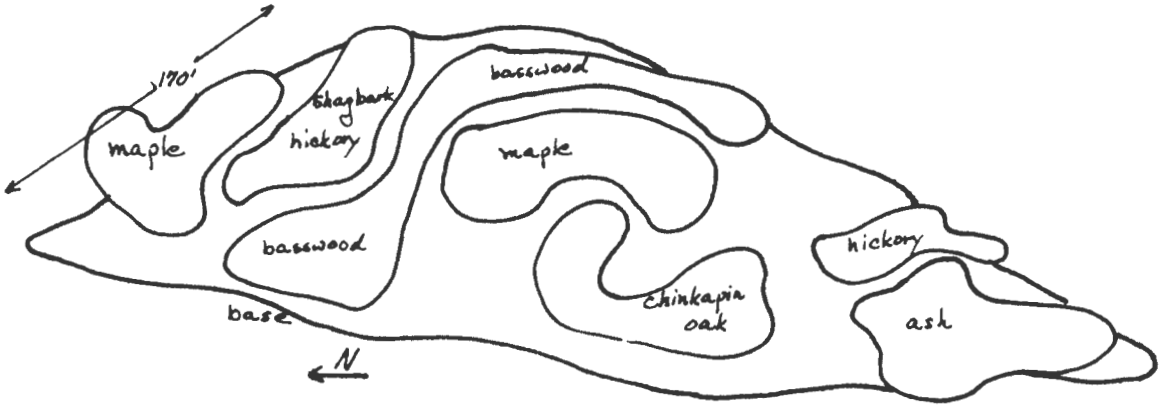



Fig. 57. Schematic diagram of study area 55

Study Area 56

The slope turns south onto a large fan-shaped area extending down to the stream at a point where two secondary

gorges empty into it. The slope is very gentle with a 40- to 50-degree drop to the stream. The community on this slope is very sparse, giving the space an open feeling. The trees have large canopies which reduce the light to 30 percent at the top of the slope, but the death of two large elms (Ulmus americana) has opened the lower slope to 80 percent light.

The understory is short with hophornbeam (Ostrya virginiana) basswood (Tilia americana), hickory (Carya ovata) and ash (Fraxinus americana). The plants are spaced out and few are in groups which is common on other slopes.

The overstory is made up of hickory, basswood, black maple (Acer nigrum), chinkapin oak (Quercus muhlenbergi) and elm. The community is not dense, making classification difficult. The major part of the living overstory is maple-basswood, which is satisfactory.

The ground on this slope is exposed in many areas from water rushing down from the top. In such areas, the litter has been removed. The undercover has not developed for this reason, and, since the disturbance is continuing, the slope has no signs of stability.

The slope makes a point at its top and fans out to a 200-foot stretch at its base. The stream at the base of this slope makes a "Y"-shape to accommodate the drainage from the two secondary gorges.


Fig. 58. Schematic diagram of study area 56

Study Area 57

The fan-shaped slope (Area 56) turns to the south and opens into another gorge. This gorge extends for 350 feet to its shallow end. This east-facing slope continues in a waving manner on its upper rim caused by washouts from run-off water above. At the longest end of the slope, the grade is gentle with a 40-degree drop. This situation changes at the shallow end where water has washed the wall of the gorge to a 95-degree drop. The base of the deep end is also washed to a 90-degree drop. The stream, which runs during wet seasons, has cut a hole through the base leaving roots exposed and causing trees on its bank to fall over. The shallow end is also cut by the same waters which have and are still washing to make the gorge longer.

The overstory is well developed with oak and hickory dominating. The oaks are more common toward the top of the slope making a danse canopy. The lower slope is not as heavily populated with basswood (Tilia americana), ash (Fraxinus americana)and maple (Acer nigrum). At points near the base of the slope, openings have been left from the falling of trees and the death of one elm (Ulmus americana). The understory follows the same pattern as the overstory, being dense at the top and thinner near the base. The understory is populated with oak (Quercus spp.) maple (Acer nigrum) and hophornbeam (Ostrya virginiana). The hophornbeam is the most prevalent species in the understory.

The undercover is very disturbed. Many areas have been washed clean and some regions are down to the gravel base. The litter has also been washed away, and, in some regions near the base, it has been deposited to form deep pockets of decaying leaves.

The base of the slope is undergoing more changes than the top because of a greater amount of disturbance. The opening created by dead and fallen trees has developed new communities with the addition of the sunlight. The undercover is beginning to cover the ground with annual species and some tree species. These changes and an apparent continuation of their causes make the slope very unstable.

The slope, as a whole, could be classified as an oak-hickory community in an unstable environment.

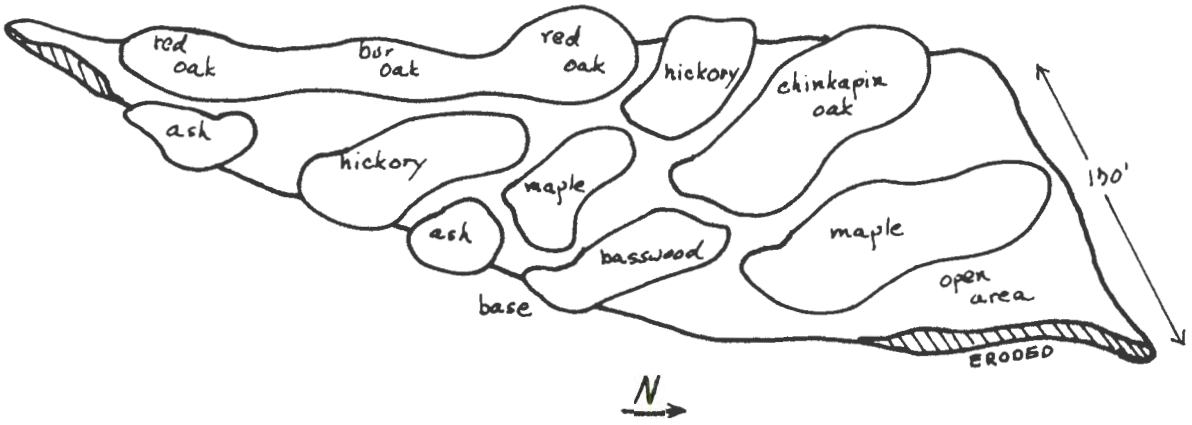



Fig. 59. Schematic diagram of study area 57

Study Area 58

The opposite side of this gorge turns to an east-northeast direction with a northwest exposure. Area 58 extends eastward for 200 feet and at its deepest point scales down 150 feet to its base. The shallow end of the slope is severely disturbed. There are two small finger-like gorges extending off the upper slope and into the main streams of the gorge. At this point, there is no undercover but only bare, exposed soil. The undercover improves as one moves to the east but at no point is it developed or stable.

The overstory is sparse, allowing much light to reach the floor. This does not aid in improving the undercover, since the erosion disturbance overpowers the advantages of light. The overstory does not have a dominant species. The red oak (Quercus borealis), black maple (Acer nigrum),

hickory (Carya ovata), and ash (Fraxinus) are equally represented. There are few elm (Ulmus americana) on the slope, and the existing ones are located on the shallow end of the gorge.

The understory is almost entirely hophornbeam (Ostrya virginiana) and elm. These are most dense at the top of the slope. There are a few maple and oak seedlings under these communities, but their future depends on the stability of the soil from which they have sprouted.

The slope is littered with branches and tree trunks. At one point on the deepest end of the slope, there is a large trunk of a dead tree still standing. The trunk has been bleached white and is visible from all portions of the slope. The branches clutter the slope so densely that certain areas are impossible to cross. The gorge at the base has cut a 100-degree drop for 10 to 20 feet, leaving large roots exposed and weakening the trees growing along the base.

The slope is difficult to classify, since no species dominates. The understory and undercover give evidence that the oak and maple may dominate in the future. This is dependent on whether the seedlings in the understory are allowed to grow or are washed away by erosion.

Study Area 59

Area 59 turns into a large barrel-shaped cut. This slope has a gentle grade at 40 degrees down to the stream

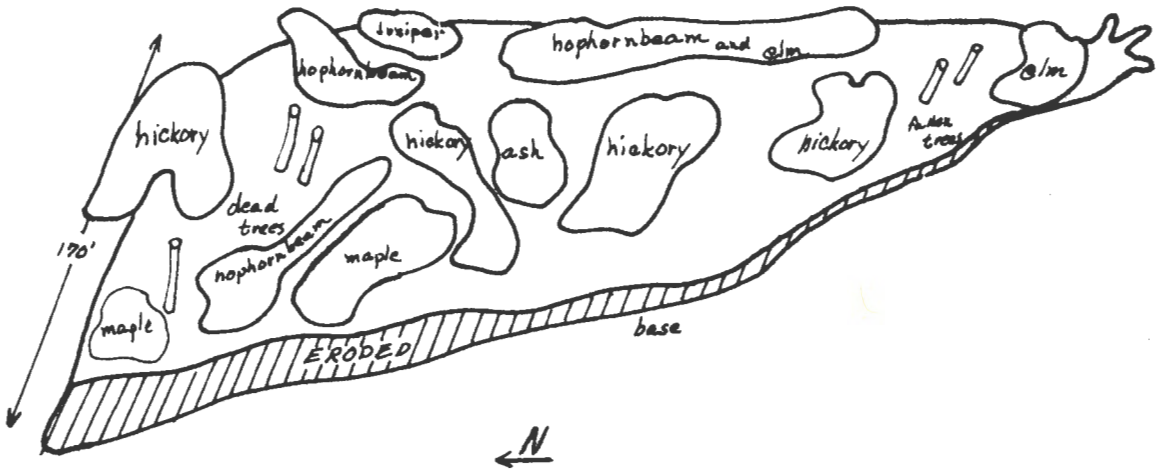



Fig. 60. Schematic diagram of study area 58

below. The upper slope is lined with vegetation along its top rim leaving the area beneath relatively open with cover from above. There the slope faces a northwest direction and is wider at the base than at the top. The widest portion across the base is approximately 120 feet.

The overstory is dense near the top and at the base of the slope leaving the center slope open. The upper overstory consists of basswood (Tilia americana) and black maple (Acer nigrum). There is also one large red oak (Quercus borealis) on the center of the upper slope. The lower edge is dominated by hickory (Carya ovata) and red oak with a few smaller maples. The trees on this slope are larger than on others in the area. Since the slope is not as steep, there is less disturbance. There is one area at center slope beginning to erode as waters from the walls accumulate here on their way to the base.

The understory is well developed with hophornbeam dominating and smaller basswood and maple beginning to make a show. Near the top of the slope a group of serviceberry (Amelanchier canadensis) remain but are being shaded out by the canopy of the basswood and oak.

The undercover is young but quite thick. The litter is holding to all portions of the slope, making it soft to walk on. There are many small limbs scattered in the undercover and one large, decayed log lies across the base of the slope.

The light is varied on the slope. Under the dense canopy near the top and base the light reaching the floor is reduced to 20 percent. This increases in the open areas and under the understory to 50 percent.

There is one trail under the trees at the top of the slope, but none are evident on lower portions of the slope. Cattle seemingly grazed the slope, because of its gentle incline but did not cut contoured trails onto it.

The slope would be classified as an oak-maple population although the hickory and basswood are quite evident.

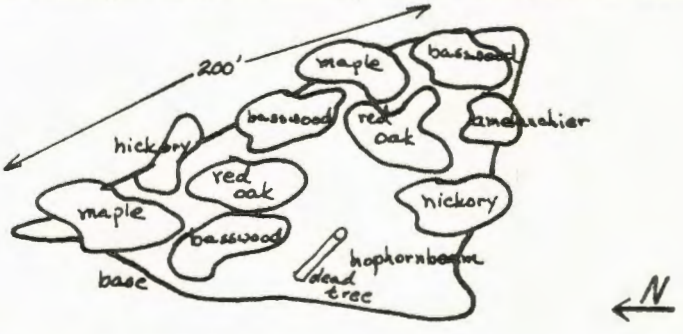



Fig. 61. Schematic diagram of study area 59

Study Area 60

As the slope emerges from the barrel-like gorge of Area 59, it continues in the same direction (northeast). This slope is very long and at its deepest end opens onto the second floodplain of Richardson's Branch. There is also a higher plateau of the floodplain region which backs into the face of the slope. The upper portion of the slope is curving south and back north as it makes its way to the mouth of the gorge. The wavy rim was caused by erosion of past years. Since then, the erosion problem seems to be isolated to very steep areas near the base of the slope. The base of the slope is relatively straight, except for a northerly curve as the gorge reaches Richardson's Creek.

The overstory is dense, reducing sunlight to 20 percent under the canopy. This is increased in areas near the base where trees have fallen and elms have died. The species found in the overstory are bur oak (Quercus macrocarpa), red oak (Q. borealis), white oak (Q. alba), basswood (Tilia americana), maple (Acer nigrum), hickory (Carya ovata) and elm (Ulmus americana). These are randomly scattered over the slope with oak and basswood dominating. There is also a heavier population near the upper edge of the slope.

The understory is spotty with species such as hophornbeam (Ostrya virginiana), elm, dogwood (Cornus racenosa), basswood, maple and oak (Quercus spp.). There are more

hophornbeam toward the top of the slope with the other species found mostly at mid-slope or lower. At one point on the upper slope, the hophornbeams are so thick that it is difficult to see beyond the small trunks. This is not the case at lower elevations where the understory is spread out.

The undercover is not continuous being thickest near the base where sunlight is in the greatest quantity. The litter is thick, giving the slope a soft feeling.

The grade of the slope varies from 50-70 degrees at its shallow end reducing to 4- degrees as the floodplain is approached. This is a drop of 90 percent along the creek bottom which has washed down to rocks.

The slope would be classified as an oak-basswood with questions about the future.

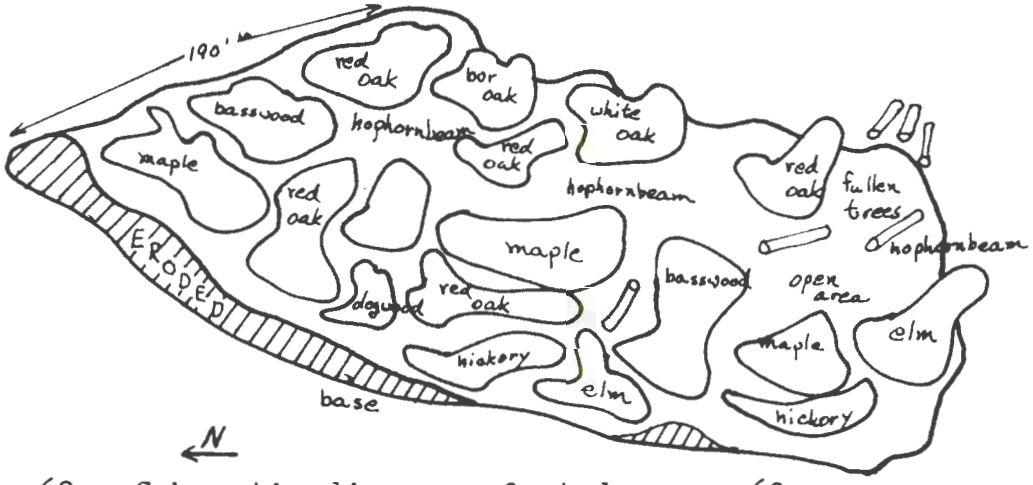



Fig. 62. Schematic diagram of study area 60

Study Area 61

This slope which faces due north may be located on Fig. 121 of the arboretum. The slope is marked on its upper edge

by a broken row of Amelanchier canadensis and at the lower edge by Richardson's Branch. The entire area has a history of having been farmed on the flat areas and having cattle grazing on the slopes. For this reason, a large number of cattle trails cut various diagonals across this particular slope. Since the purchase of the land by 4-H in 1950, the farming and grazing has been discontinued. The runoff from the slope has maintained the cattle trails and in some places caused serious erosion problems. At one point, the remains of a barbwire fence, which is girdling trees, gives some evidence of past farming practices.

The upper portion is steeply sloped with an approximate grade of 60 degrees reducing to 30 degrees in the mid-section and to a flat area at the base. The upper portion also has the greatest population of overstory trees which reduce the sunlight reaching the floor to 20 percent. The mid- and lower portions are less densely populated with about 50 percent sunlight reaching the floor. There was also a dense population of elm trees which have died and have increased the open area on these sections of the slope.

The vegetation of the slope includes oak, maple, basswood, elm, honey locust, Amelanchier, hickory, ironwood, ash, eastern red cedar, and willow, occurring in varying numbers and in most cases grouped in various locations on the slope.

The upper portion of this slope is populated with Acer nigrum and Quercus borealis. These trees have a sparse

understory of Ostrya virginiana and a limited undercover. Above this population is a scattered group of Amelanchier canadensis marking the top of the slope. The mid-slope is populated with Quercus borealis and Tilia americana with Ostrya ovata. Carya glabra and Ulmus americana randomly located in this region. The understory in this location consists of Quercus borealis, Acer nigrum and Ulmus americana. The understory and undercover is more dense than the upper slope due to openings in the overstory created by dead elm trees.

The lower portion of the slope is dominated by groupings of Fraxinus nigra and Carya glabra. The population also includes Gleditsia triacanthos, Salix interior, Juniperus virginiana and Quercus borealis. There is little understory in this area due to disturbance from the floodplain and past grazing practices. Kentucky bluegrass make up the greatest portion of the undercover toward Richardson's Branch.

There is little litter on the floor of this slope, probably due to the sparse undercover and the removal of litter by runoff. This is apparent by the thick buildup of litter in low areas and in trail bottoms near the base of the slope.

The entire slope is dominated by Acer nigrum, Quercus borealis and Tilia americana. The slope is undergoing fast changes due to the death of several large elm trees. The seedlings under such areas are re-establishing the maple, oak and elm, indicating that the maple and oak will probably dominate.

The high population of elm on this slope makes it unsuitable for use as a stable area, and the erosion created by cattle trails makes it unsuitable for nature trails, unless contoured trails could lead in from adjoining slopes. In establishing a classification for this slope, the evidence would indicate an oak-maple-basswood population dominating.

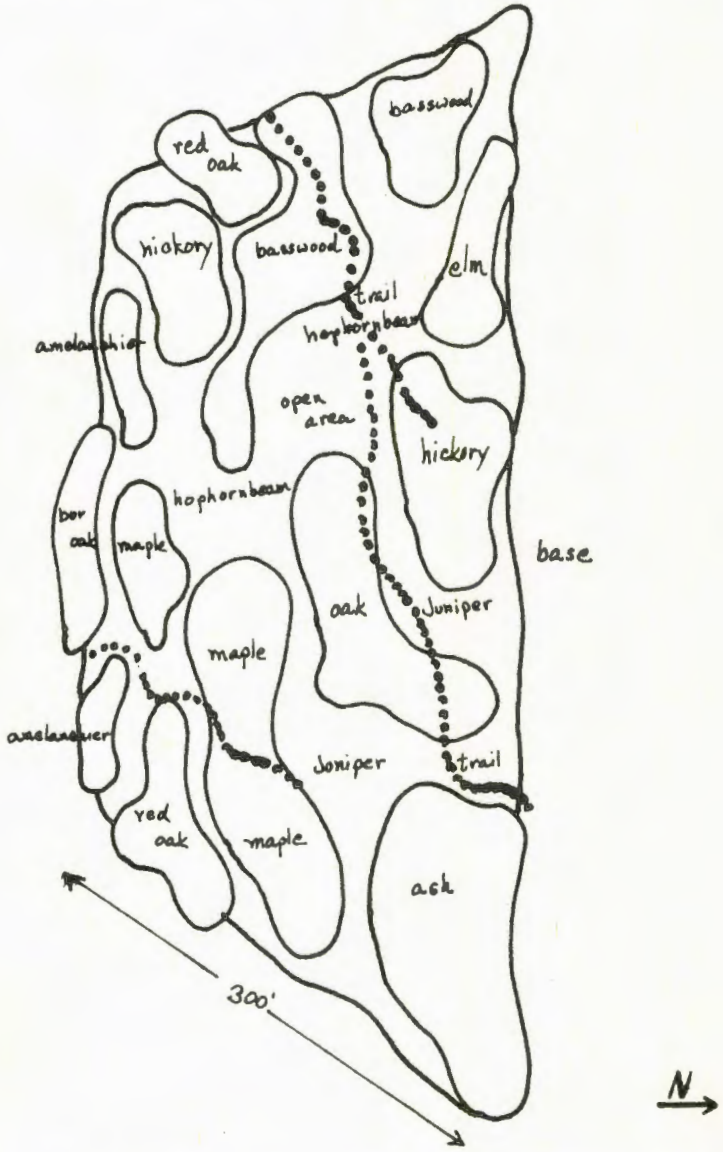



Fig. 63. Systematic diagram of study area 61

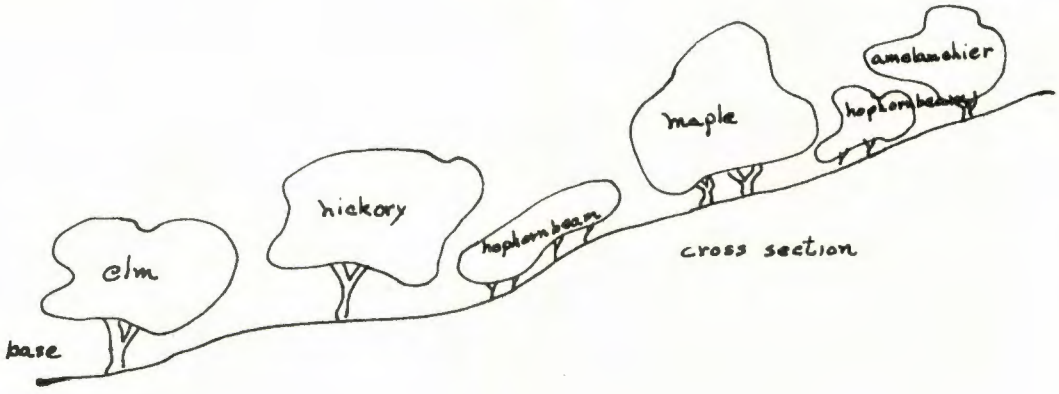



Fig. 63 (Continued)

Study Area 62

Area 62 is a large northeast-facing slope which borders the floodplain of Richardson's Branch. The slope stretches approximately 230 feet down its face with an 80-degree grade. The soil trickles down the slope with each rain and a major washout appears at center slope. Trails cut contours across the face of the slope but are washed out at the center of the slope.

The overstory population was dominated by elm (Ulmus americana) but their death has left a cemetery of dead, bleached-white trunks on all portions of the slope. The canopy now covers only the top of the slope. The species represented here are red oak (Quercus borealis), hickory (Carya glabra), basswood (Tilia americana) and maple (Acer nigrum). The understory is more diversified with hophornbeam (Ostrya virginiana), red mulberry (Morus rubra), red cedar (Juniperus virginiana), serviceberry (Amelanchier canadensis) and elm (Ulmus americana) populating this strata.

The undercover is disturbed with water eroding its surface and branches falling from dead trees.

Center slope is completely washed away but not from runoff. The center of the slope contains a spring which runs during the wet seasons, causing the sandy soil to tumble down the slope into Richardson's Branch.

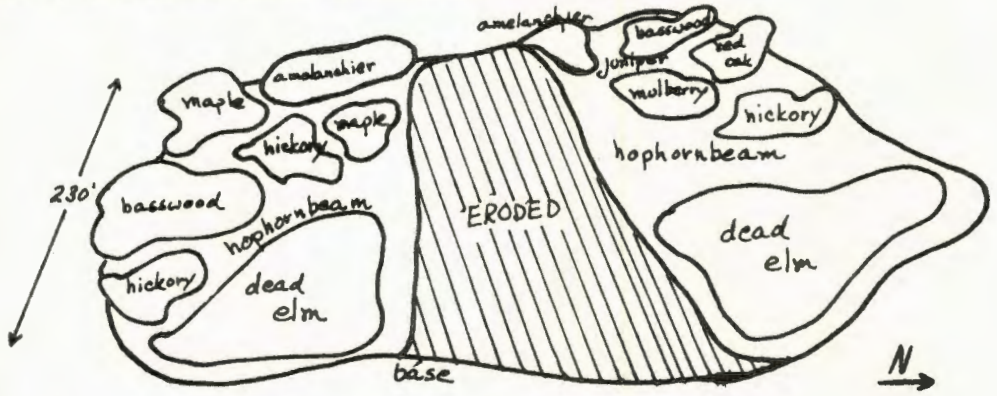



Fig. 64. Schematic diagram of study area 62

Study Area 63

Area 63 stretches away from Richardson's Branch into a drainage gorge. The slope is exposed to the south and southwest, as it turns northerly at its shallow end. With a length of 300 feet, the deepest portion of the slope reaches 230 feet to a creek emptying into Richardson's Branch. The slope surface as well as the vegetation is stable and not disturbed by elements which are common in this region.

The overstory is thick with a canopy that reduces light by 70 percent. The dominants in this strata are oak (Quercus macrocarpa, Q. macrocarpa, Q. muhlenbergi, Q. alba, Q. borealis) and hickory (Carya ovata, C. glabra) with black walnut

(Juglans nigra), maple (Acer nigrum), basswood (Tilia americana), elm (Ulmus americana) and serviceberry (Amelanchier canadensis) sparsely spread across the slope. The understory is well developed with most of the overstory species represented. Hophornbeam dominates, being especially thick across the center of the slope. Red cedar (Juniperus virginiana)are sparsely mixed in the understory. The undercover is diversified with a heavy layer of litter mulching its growth. This slope has had an abundance of perennials which bloom in the early spring before most species begin to grow.

The slope is steep but easily walked since contours have developed naturally as water carved the face of the slope. This area is one of the least disturbed locations, representing a well developed oak-hickory community.


Fig. 65. Schematic diagram of study area 63

Study Area 64

The region designated as Area 64 consists of a slope 280 feet long with a depth ranging from 6 to 200 feet. The slope has a grade of 70 degrees which curves around a knoll. The slope is exposed to the south and southwest, as it bends to the end of the gorge.

The slope is covered with a dense canopy which reduces light reaching the floor to 20 percent. The overstory is old, well developed and reproducing in both the understory and undercover. The randomness and assortments of the species creates a situation where many trees hold equal dominance. Basswood (Tilia americana) and oak (Quercus alba, Q. borealis, Q. macrocarpa, Q. muhlenbergi) cover equal proportions and slightly more than other species. Walnut (Juglans nigra), maple (Acer nigrum), ash (Fraxinus americana) and elm (Ulmus americana) are well sorted through the community.

The understory is thick and dominated by hophornbeam, having each of the overstory species represented. The undercover spreads over the slope completely, and a vast litter from the trees above produce a blanket covering the slope. The slope appears to be undisturbed and recommendations for the area would be preservation as it is.

Study Area 65

The cover on this area varies from a thick canopy on the shallow end to a sparse covering on its deep end. The

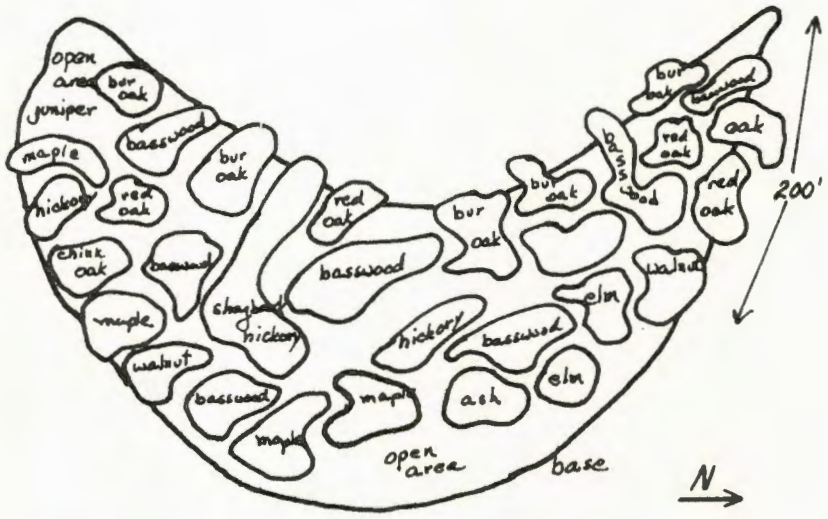



Fig. 66. Schematic diagram of study area 64

grade varies from 50-90 degrees being steepest on the shallow end. With a depth of 180 feet, the slope stretches out to approximately 340 feet including two smaller gorges cradled along the top rim.

Elm has played an important role in producing the canopy, and today, as the elms die, large areas are open to greater amounts of light and vegetation changes. Basswood (Tilia americana), hickory (Carya ovata, C. glabra) and walnut (Juglans nigra) cover equal areas and hold equal dominance. Other species found in smaller quantities are ash (Fraxinus pennsylvanica lanceolata), serviceberry (Amelanchier canadensis) and elm (Ulmus americana).

The understory is dominated by hophornbeam (Ostrya virginiana) with walnut (Juglans nigra), elm (Ulmus americana), maple (Acer nigrum) and hickory (Carya ovata) found under mother trees of the overstory. The groundcover is sparse but

already species are beginning to move into areas opened by the death of elm. This slope will undergo considerable change as vegetation shifts from elm domination to other species.


Fig. 67. Schematic diagram of study area 65

Study Area 66

This region consists of a small disturbed slope sparsely populated in all strata. The elm which dominates the slope, covering 40 percent of its surface, have died producing a cascade of dried trunks and limbs on every section of slope. The remaining canopy is dominated by walnut (Juglans nigra) with basswood (Tilia americana), oak (Quercus macrocarpa) and hickory (Carya ovata) represented by single specimens.

The understory is rapidly changing with the introduction of greater light. The slope is exposed to an easterly

direction opening onto the valley of Richardson's Branch. Red cedar (Juniperus virginiana) and serviceberry (Amelanchier canadensis) are found in the understory which is dominated by hophornbeam (Ostrya virginiana). The undercover is sparse with a few woody species present.

The dimensions of the slope include a length of 110 feet and a depth of 180 feet. The grade averages 70 degrees, and the southern edge is eroding with each rain.

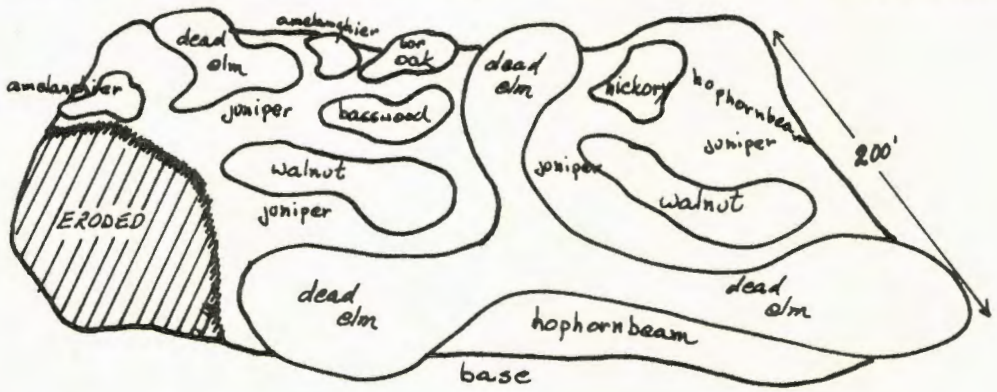



Fig. 68. Schematic diagram of study area 66

Study Area 67

This area intersects with Area 66 forming a ridge having a drop of 40 degrees. The base of the ridge is eroded and steep, as shown on Map 1. The area is exposed to the east, extending down a sloping surface approximately 180 feet to the floodplain below. A sparse collection of species border the top rim which stretches 550 feet and slopes down gently on its southern end.

Like other areas bordering the floodplain, Area 67 leaves the slope sparsely populated and without cover in

many areas. The overstory contains many species, having no dominant distributed across the slope. Maple (Acer nigrum), walnut (Juglans nigra), hackberry (Celtis occidentalis), honey locust (Gleditsia triacanthos), oak (Quercus macrocarpa, Q. muhlenbergi, Q. borealis), hickory (Carya ovata, Carya glabra), red mulberry (Morus rubra), box elder (Acer negundo) and ash (Fraxinus Pennsylvanica lanceolata) are all present in the canopy, many in equal numbers. The understory contains many maple and basswood seedlings but is dominated by honey locust and hophornbeam (Ostrya virginiana). Undercover and litter is sparse at present but shows signs of thick development under areas once covered by elm.

The top ridge of this area forms a good overlook for the Richardson's Branch valley and the opposite slope to the east.

Study Area 68

This triangular-shaped area is approximately 300 feet long. The grade is 20 to 30 degrees, and, at one time, the slope's center was used as a road to transport coal from strip mines below. The portion used as a road has eroded and now forms a ten-foot trench down the center of the slope. Small trees border the trench and both sides of the slope. A number of species appear here with most being represented by one tree. Honey locust (Gleditsia triacanthos),

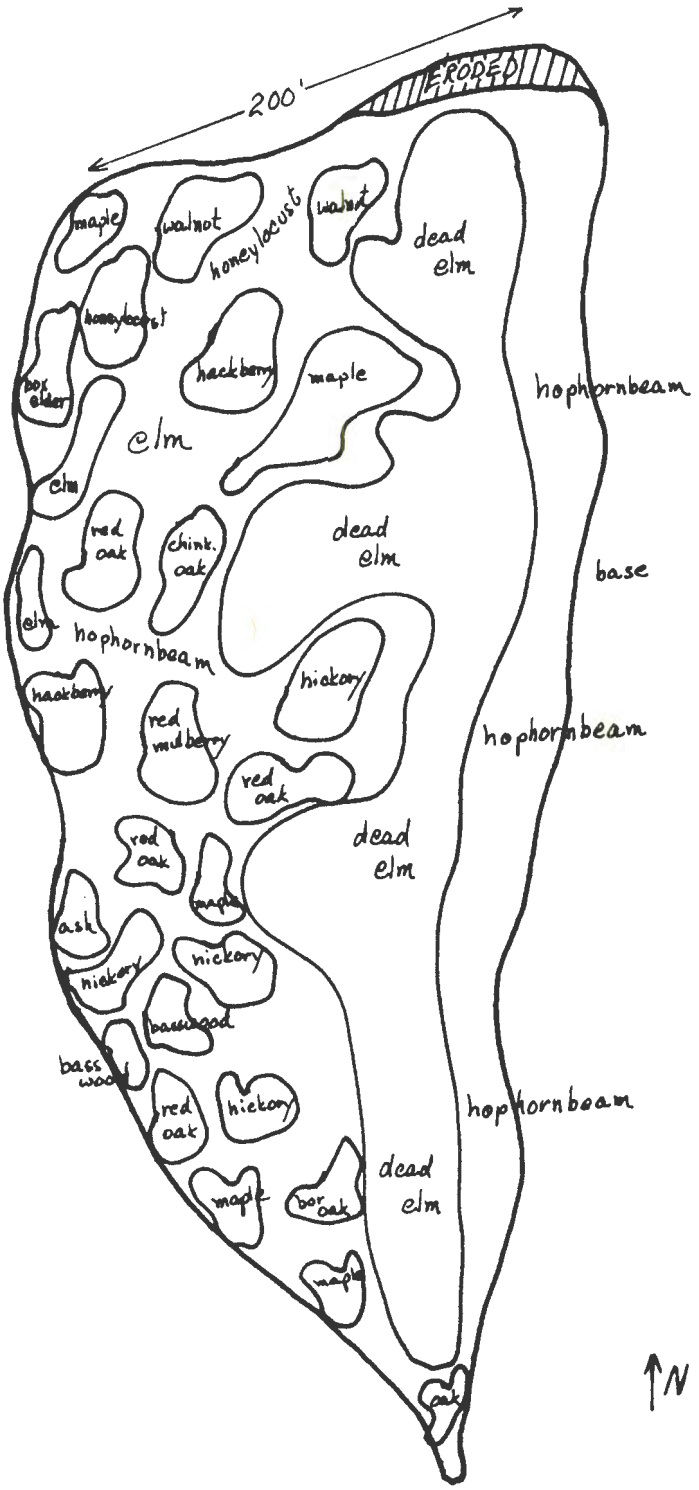



Fig. 69. Schematic diagram of study area 67

cottonwood (Populus deltoides), shagbark hickory (Carya ovata), basswood (Tilia americana), elm (Ulmus americana), hackberry (Celtis occidentalis), bur oak (Quercus macrocarpa) and aspen (Populus tremuloides) are all found here producing a young overstory. The understory is not developed except for a few red cedar (Juniperus virginiana) and serviceberry (Amelanchier canadensis) on the flat surfaces with hophornbeam growing at the base of the old road.

The undercover is thick, covering the entire area. This slope is an excellent area to use in developing a major trail to the base of the gorge.

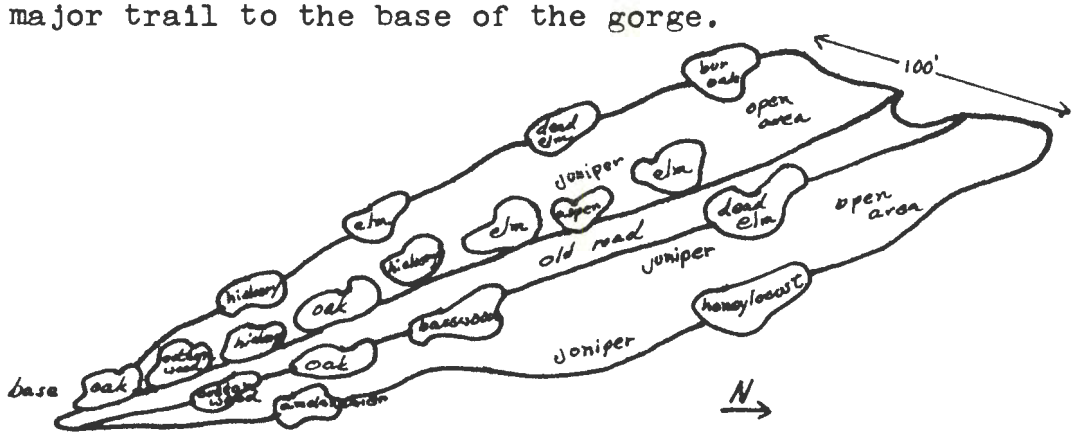



Fig. 70. Schematic diagram of study area 68

Study Area 69

A section north of Area 68 slopes to the base of a gorge extending to the west. This section is 300 feet long and 150 feet deep at its center. The grade is steep at 70 degrees making movement difficult.

The overstory is concentrated on the upper extremes of the slope towering over the lower areas. Oak dominates

(Quercus alba, Q. muhlenbergi, Q. macrocarpa, Q. borealis) with maple (Acer nigrum), hickory (Carya ovata), hackberry (Celtis occidentalis) and honey locust (Gleditsia triacanthos) adding diversity to the community. The understory includes red cedar (Juniperus virginiana), hornbeam (Carpinus caroliniana), hophornbeam (Ostrya virginiana) and elm (Ulmus americana). This strata is developed under the canopy but does not exist in open areas near the base. The undercover is well developed and a vast leaf production leaves deep litter across the face of the slope.

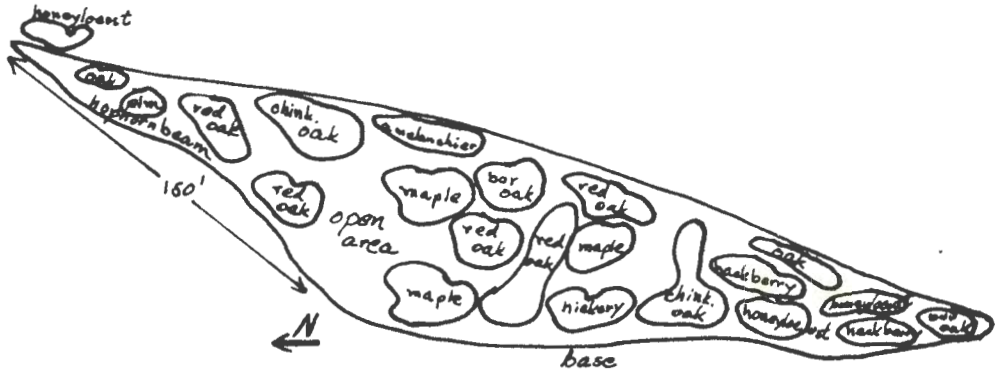



Fig. 71. Schematic diagram of study area 69

Study Area 70

The slope opposite Area 69 is not as long as its neighbor. It stretches only half this distance and turns westerly into a second gorge. Maple dominates this east-facing slope with walnut (Juglans nigra), red oak (Quercus borealis) and honey locust (Gleditsia triacanthos) being the only other additions. The canopy covers 80 percent of the slope, reducing light to 30 percent. The understory is not developed,

except for a few black maple growing under mother trees and one juniper (Juniperus virginiana). Groundcover on this slope lacks diversity but grows over the entire slope. Litter produced by the canopy remains on the surface acting as a mulch in some areas.

The maples on this slope are old, and their branching habit indicates that most were openly grown. The canopy has developed a full cover with a relatively small number of trees.

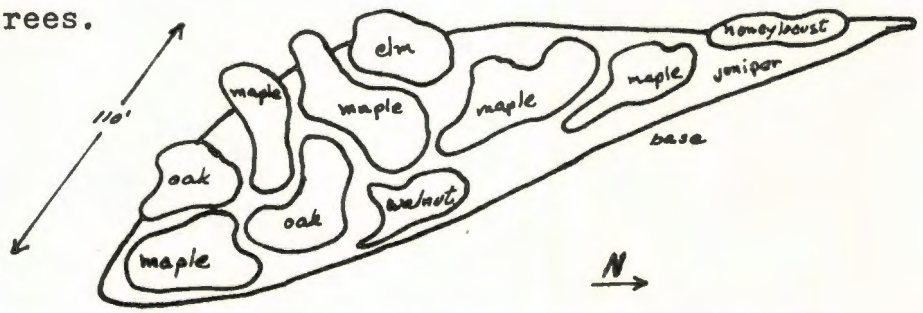



Fig. 72. Schematic diagram of study area 70

Study Area 71

Area 71 is a small triangular-shaped slope which is exposed to the south and carving into a small ravine to the north. The slope is 150 feet long and 100 feet deep with a grade of 70 degrees.

The overstory contains few trees including elm (Ulmus americana), basswood (Tilia americana) shagbark hickory (Carya ovata), chinkapin oak (Quercus muhlenbergi) and maple (Acer nigrum). The dominants are maple and oak. The understory and undercover are the same as Area 70 being sparse and undiversified. Litter does not remain as well on

this slope, since water moves much of it to the base. There are no trails on this slope, but walking is made easy by contours developed when the gorge was initiated.

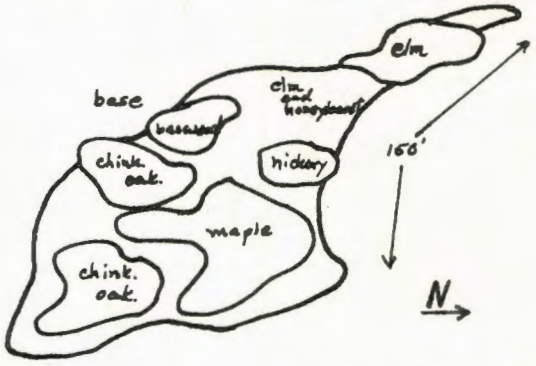



Fig. 73. Schematic diagram of study area 71

Study Area 72

The smaller branches of the major gorge become more shallow, as the floor of the gorge reaches higher elevations. This area extends vertically 90 feet at its deepest penetration and has a length of 80 feet. The grade is steep at 80 degrees with its face exposed to the east.

Overstory trees cover the entire slope, producing a canopy that reduces light to 10 percent. Oak (Quercus macrocarpa), maple (Acer nigrum), hickory (Carya ovata) and basswood (Tilia americana) are the only overstory species, and these are dominated by oak and maple. Hophornbeam (Ostrya virginiana) dominates the understory with serviceberry (Amelanchier canadensis) inhabiting the rim of the gorge and seedlings from overstory trees beginning to reach into this strata.

The floor of this slope is stabilized by a thick groundcover which is mulched by the heavy litter falling from overstory trees. The slope is steep, difficult to walk and is best observed from some vantage on Area 71.

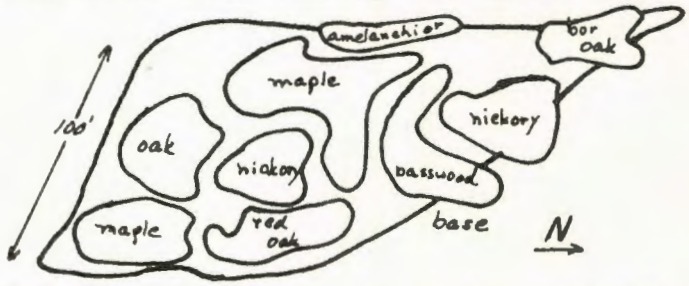



Fig. 74. Schematic diagram of study area 72

Study Area 73

This sparse community is located on the southern end of the property and may be located on Fig. 121. The population consists of oak (Quercus alba, Q. muhlenbergi, Q. borealis, Q. macrocarpa), shagbark hickory (Carya ovata), maple (Acer nigrum) and elm (Ulmus americana) with these latter species represented by a single tree. The oak forms 90 percent of the existing canopy and dominates the community. The lower slope is open, and at this point, the understory reaches maximum development. Other sections of the slope have a sparse understory with only hophornbeam (Ostrya virginiana) represented. The surface is stabilized by groundcover over all portions with a thick, leaf mulch produced by the canopy.

The slope is steep and, like its neighbor Area 72, is best viewed from the flat surface above. The upper rim of Area 73 is 140 feet long and has a vertical drop of 100 feet.

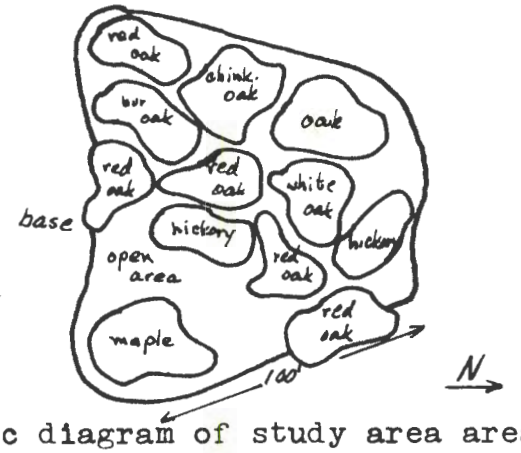



Fig. 75. Schematic diagram of study area area 73

Study Area 74

Area 74 begins as a south-facing slope and turns sharply into a small gorge exposing its surface to the west. The length of the slope is 200 feet, and its depth reaches a vertical drop of 100 feet. The grade ranges from 40 to 80 degrees being steeper as the gorge becomes shallow.

The overstory is grouped at two locations, one on the rim of the slope over the shallow end and another down the center of the deep end. Oak (Quercus alba, Q. borealis) and hickory (Carya ovata, C. glabra) dominate both populations and are supported by basswood (Tilia americana) boxelder (Acer negundo) and maple (Acer nigrum) in producing the canopy. Openings appear across the slope, since the overstory is concentrated in two areas.

The understory has not developed, and only serviceberry (Amelanchier canadensis) and hophornbeam can be found in this strata. The undercover does well to cover the slope, since some areas are sparse, but there is no water erosion.

The shallow end of this gorge finds a large pile of tree stumps which were removed from the flat surfaces above the gorge. These have been burned, but their charred skeletons remain in this 15-foot pile.

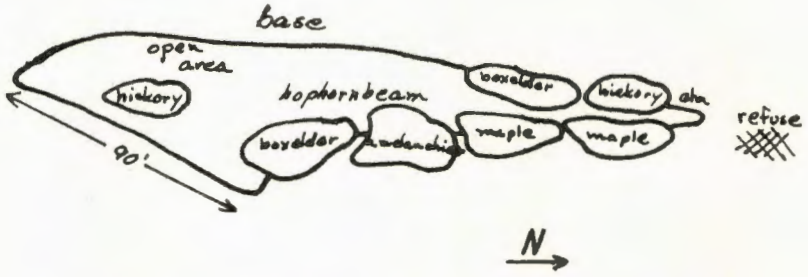



Fig. 76. Schematic diagram of study area 74

Study Area 75

This easterly exposed slope has a dense canopy dominated by maple (Acer nigrum) and basswood. The community includes oak (Quercus alba, Q. macrocarpa, Q. borealis), hickory (Carya ovata, C. glabra), elm (Ulmus americana) and ash (Fraxinus pennsylvanica lanceolata), building a cover that reduces light to 20 percent. The understory is sparse being developed near the top and absent at the base. Hophornbeam (Ostrya virginiana) dominates this strata with intrusions by basswood and maple. The cover on the surface is sparse, leaving areas exposed and subject to erosion when rain washes down from the top rim.

The area has a length of 250 feet and a vertical drop of 90 feet. The grade ranges from 80 to 90 degrees, being steepest at the deep end. The vegetation seems to be

developing into a strong maple-basswood association, since their seedlings are beginning to grow in the undercover.

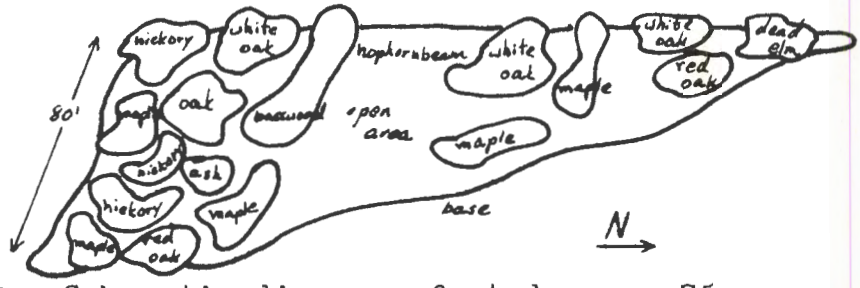



Fig. 77. Schematic diagram of study area 75

Study Area 76

This small area contains only nine overstory trees with a limited understory of hophornbeam (Ostrya virginiana). The overstory is dominated by maple (Acer nigrum) and includes basswood (Tilia americana) and chinkapin oak (Quercus muhlenbergi).

Large portions of the surface are not covered by overstory vegetation, and, as a consequence, the undercover has grown to a height of two feet over large sections.

The slope is small, being 110 feet long and having a vertical drop of 90 feet while the surface falls rapidly with a grade of 80 degrees. A small section at the base has been eroded by the stream at the bottom of the gorge. This will continue as the stream cuts deeper channels with each rain.

The slope is of little value, since the vegetation in the overstory is young. It could be used to study association development, since the slope is exposed to a due south direction.

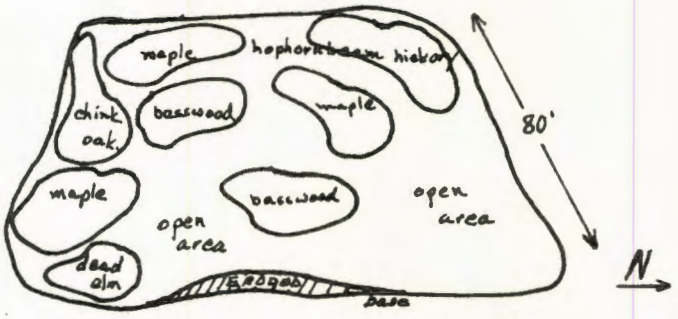



Fig. 78. Schematic diagram of study area 76

Study Area 77

This slope is exposed to the west as it borders a gorge slicing in a northerly direction. The vegetation has been scattered by uprooted trees falling across the face of the slope. The overstory has since developed new dimensions with younger trees. Oak (Quercus muhlenbergi, Q. alba, Q. borealis, Q. macrocarpa) with maple (Acer nigrum), basswood (Tilia americana), hickory (Carya ovata) and elm (Ulmus americana) also found in fewer numbers.

There is no understory, leaving the visual level of the slope unobstructed. The surface is covered by a mat of litter with a sparse undercover growing through this mulch.

The slope stretches a length of 200 feet with a vertical drop of 80 feet at its deepest point. The grade averages 60 degrees, and the slope is easily walked except for places where large trunks block the path.

Study Area 78

Stretching to a length of 200 feet, this area forms the western wall of a short drainage system. The area slopes with

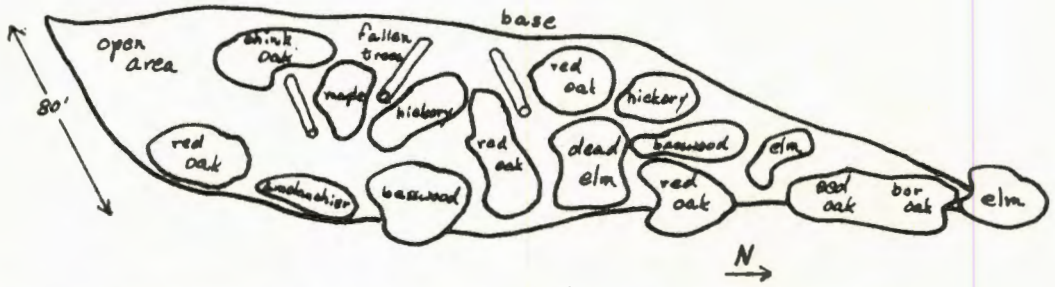



Fig. 79. Schematic diagram of study area 77

a grade of 60 degrees and a vertical drop of 80 feet at its deepest end. The top rim of the slope is covered by an oak dominated canopy which hangs over its base. The lower sections of the slope are free of any overstory vegetation and remain open with only a spotty understory. Large trees have fallen near the center of the slope, and their remains are slowly deteriorating.

Species contained in the overstory include oak (Quercus alba, Q. Muhlenbergi, Q. borealis, Q. macrocarpa), shagbark hickory (Corya ovata), cottonwood (Populus deltoides), black walnut (Juglans nigra), maple (Acer nigrum) and pignut hickory (Carya glabra).

The understory is sparse containing only two species, hophornbeam (Ostrya virginiana) and maple. The undercover maintains sufficient growth to stabilize the surface leaving some areas bare with only a litter mulch.

The slope is easily maneuvered, especially near its base.

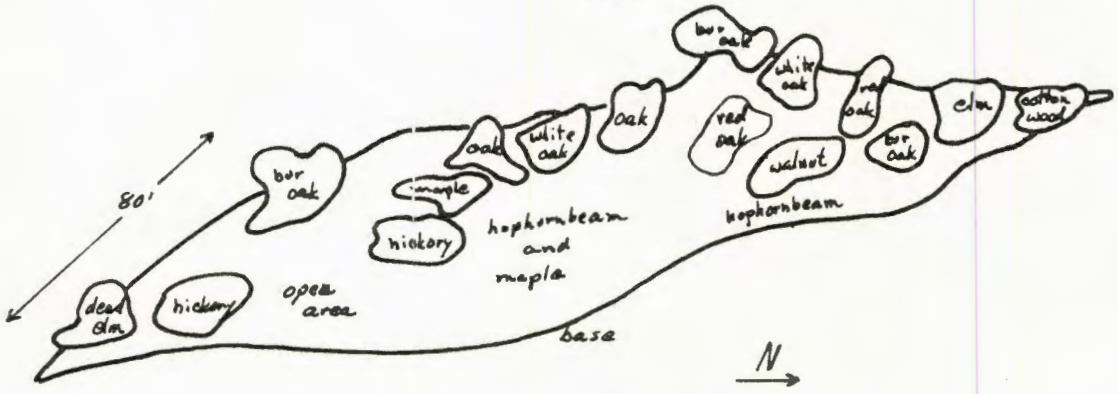



Fig. 80. Schematic diagram of study area 78

Study Area 79

Area 79 is a southerly exposed slope which follows a gorge which continues off the property used by the arboretum. A fence dissects the slope's face in a north-south direction and probably marks the east end of a 40-acre section. The description of this slope will continue for 100 feet beyond the fence, since the vegetation may prove important for study.

The overstory is dominated by oak (Quercus macrocarpa), Q. alba, Q. muhlenbergi, Q. borealis) with maple (Acer nigrum), basswood (Tilia americana) and hickory (Carya glabra) adding diversity to the community. The overstory community is clustered leaving large, open areas at points on the slope.

Hophornbeam (Ostrya virginiana) dominates a sparse understory which includes maple and oak distributed in few numbers. The cover is washed clean by rain moving down the slope to the creek below. The base has been eroded by the creek as it channels deeper with each rain.

The slope is 70 feet deep with a grade of 60 degrees and a length of 200 feet. There are no trails on this slope, but walking is made easy if one follows contours at all levels.

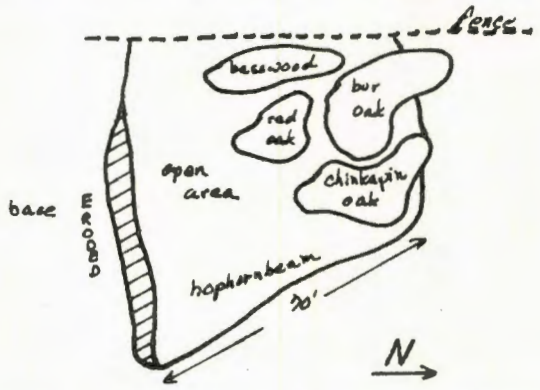



Fig. 81. Schematic diagram of study area 79

Study Area 80

Area 80 is part of a slope system bordering the east bank of Richardson's Branch. Its north edge is marked by a fence erected on the property line, and its base is adjacent to the creek and portions of the floodplain. The surface is exposed to the west with portions partially exposed to the south. Vegetation has been severely disturbed by grazing livestock and timber operations. Oak trees have been cut and remain scattered across the surface leaving large openings in the canopy. Disturbances have caused small mudslides which leave portions of the slope without cover and susceptible to further erosion. Lower levels have been gorged by the creek leaving unstable conditions across much of the base. This area has a vertical drop of 160 feet and a length of approximately 440 feet. The grade varies from 40-80 degrees being more drastic in eroded areas.

The overstory is dominated by oaks (Quercus alba, Q. borealis, Q. muhlenbergi, Q. macrocarpa) which are scattered in a broken canopy. The canopy reduces the light reaching the floor by 30 percent which is relatively low for wooded slopes in the area. Other species included in the canopy are black maple (Acer nigrum), shagbark hickory (Carya ovata) and elm. The canopy is not diversified as indicated by the few species represented.

The understory is underdeveloped on 90 percent of the surface as evidence of past disturbances. Portions which have developed consist only of hophornbeam (Ostrya virginiana) with a few scattered red cedar (Juniperus virginiana). The situation is unusual for the area, since vision is not obstructed by brush or small trees.

The undercover efficiently covers the surface, except on portions where erosion has removed vegetation. The cover is not diversified, consisting of a thick mat of bluegrass. A small amount of litter is found on the slope, since production is low, and that produced accumulates at the base of the slope. There are no seedlings of overstory trees found on the undercover. It will take time for woody species to fill the openings in the canopy.

Although the slope has no trails across its surface, it is quite easily walked. The grade is constantly changing from section to section forming contours which might some day be used for footpaths.

The largest eroded area is beginning to be stabilized by vegetation with hophornbeam, hickory and butternut (Juglans cinerea). This trend may continue, since the creek has shifted and does not border the base, as it has in the past.

Study Area 81

This area extends to the east into a gorge carved by waters from fields above. The surface slopes at a grade of 50 degrees over the top half and is more critical at the base where erosion continues to cut a straight wall into its face. The area has a length of approximately 250 feet and a vertical drop of 130 feet, at its deepest end. The surface is exposed to the east. The position of the slope can be located on Fig. 121.

A canopy dominated by oak covers the top half of the slope. Species included are red oak (Quercus borealis), chinkapin oak (Q. muhlenbergi), white oak (Q. alba), bur oak (Q. macrocarpa), black maple (Acer nigrum), elm (Ulmus americana), basswood (Tilia americana), ash (Fraxinus pennsylvanica lanceolata) and shagbark hickory (Carya ovata). The canopy is not thick allowing much light to reach the surface.

The understory is disturbed and underdeveloped. Hophornbeam (Ostrya virginiana) and red cedar (Juniperus virginiana) are the only species found in this strata. The sparseness of both the overstory and understory allows a thick mat of grass to cover the surface. This cover is not diversified

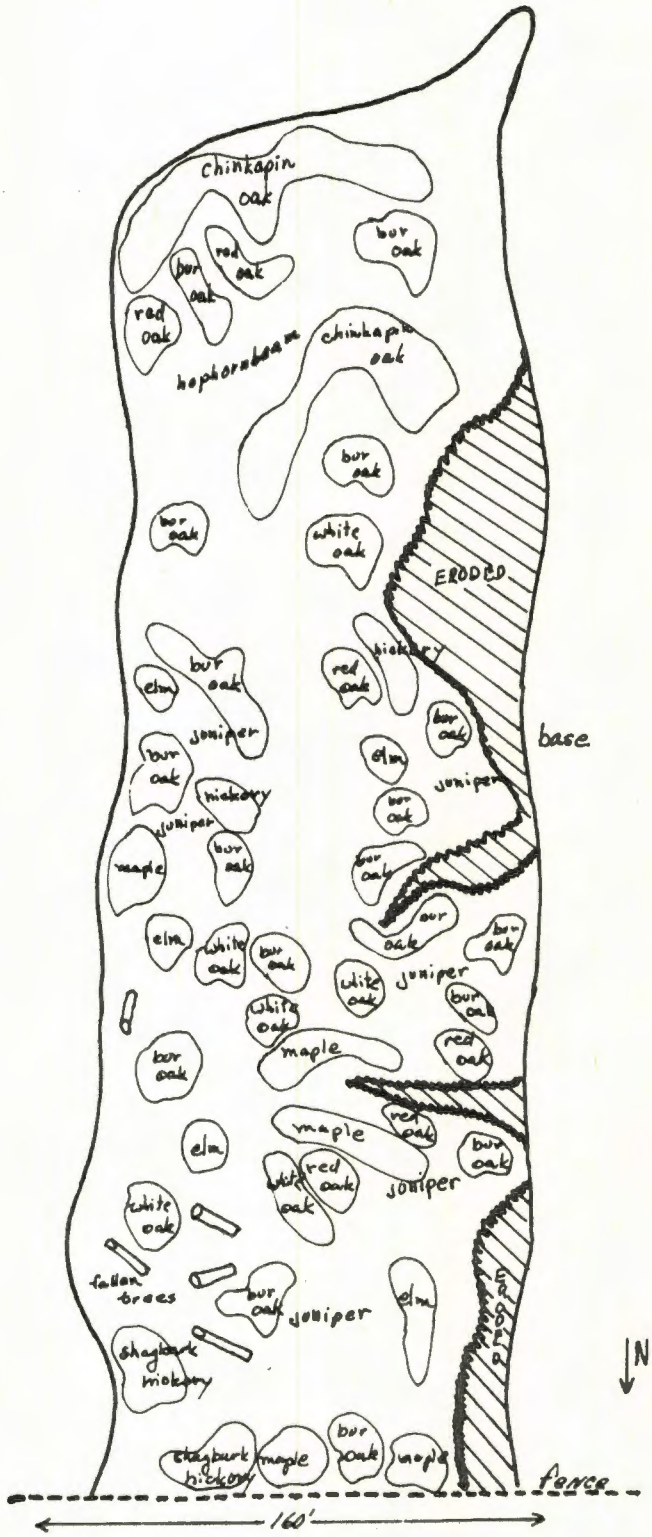



Fig. 82. Schematic diagram of study area 80

but covers the slope well, except for eroded sections which are stripped of vegetation. Litter production is sparse, and most of that produced is removed by wind and rain.

This area is extensively disturbed, and before use can be made of the slope, steps must be taken to stop erosion and re-establish some vegetation cover.

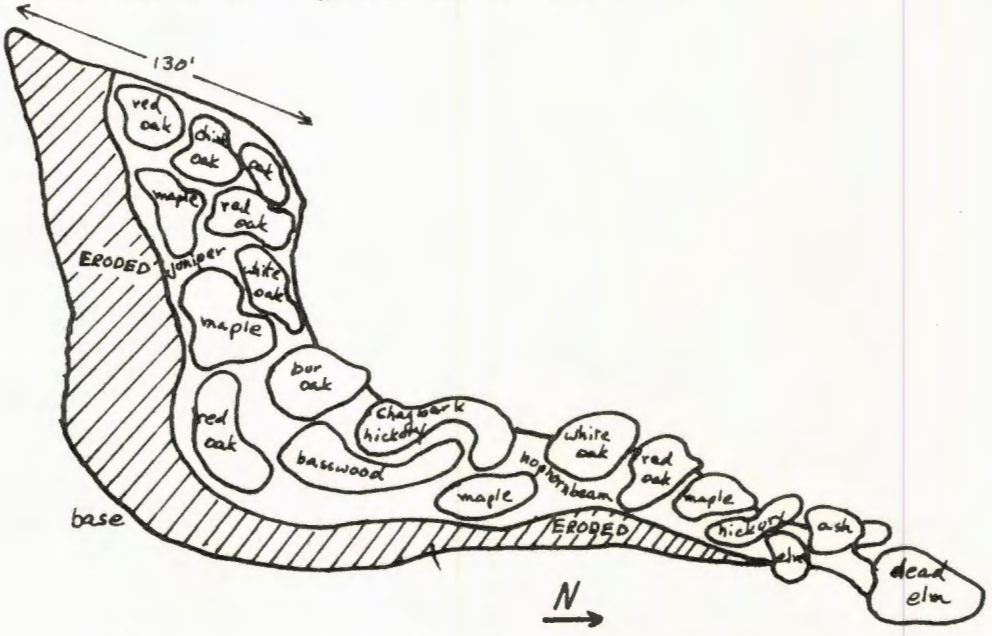



Fig. 83. Schematic diagram of study area 81

Study Area 82

Area 82 forms one side of the gorge opposite Area 81. It follows the same lines as Area 81 with its slope being exposed to opposite directions. The largest portion of the slope is exposed to the north with the shallow end facing the west. At one point, the slope extends into a small gorge formed to the east which may be noted on the diagram which follows. The grade of this slope is greater than the

neighboring slope, dropping 60 degrees on its shallow surfaces and 90 degrees on other sections. Erosion is more severe leaving the surface unstable with little cover. Vegetation is concentrated on the shallow end of the area. The deeper portions of the area are completely eroded with few overstory trees. Area 82 is approximately 300 feet long having a vertical drop of 130 feet at its deepest point.

Disturbances have left the overstory dominance shared by a number of species: oak (Quercus macrocarpa, Q. borealis), maple (Acer nigrum) and hickory (Carya ovata, C. glabra) cover equal portions of the slope with basswood (Tilia americana), hackberry (Celtis occidentalis), cottonwood (Populus deltoides), elm (Ulmus americana) and honey locust (Gleditsia triacanthos) covering smaller areas. The overstory trees are relatively young, clustered toward the top surface of the slope.

The understory is sparse, consisting mostly of hophornbeam and sumac (Rhus glabra) with oak and maple establishing themselves on some eroded surfaces. The understory is undeveloped, since the erosion power of water has prevented the establishment of such cover. Litter is also absent, since it like the soil is washed to the base of the slope.

Study Area 83

The section designated as Area 83 is unusual for the region in study. It consists of a large slope which is

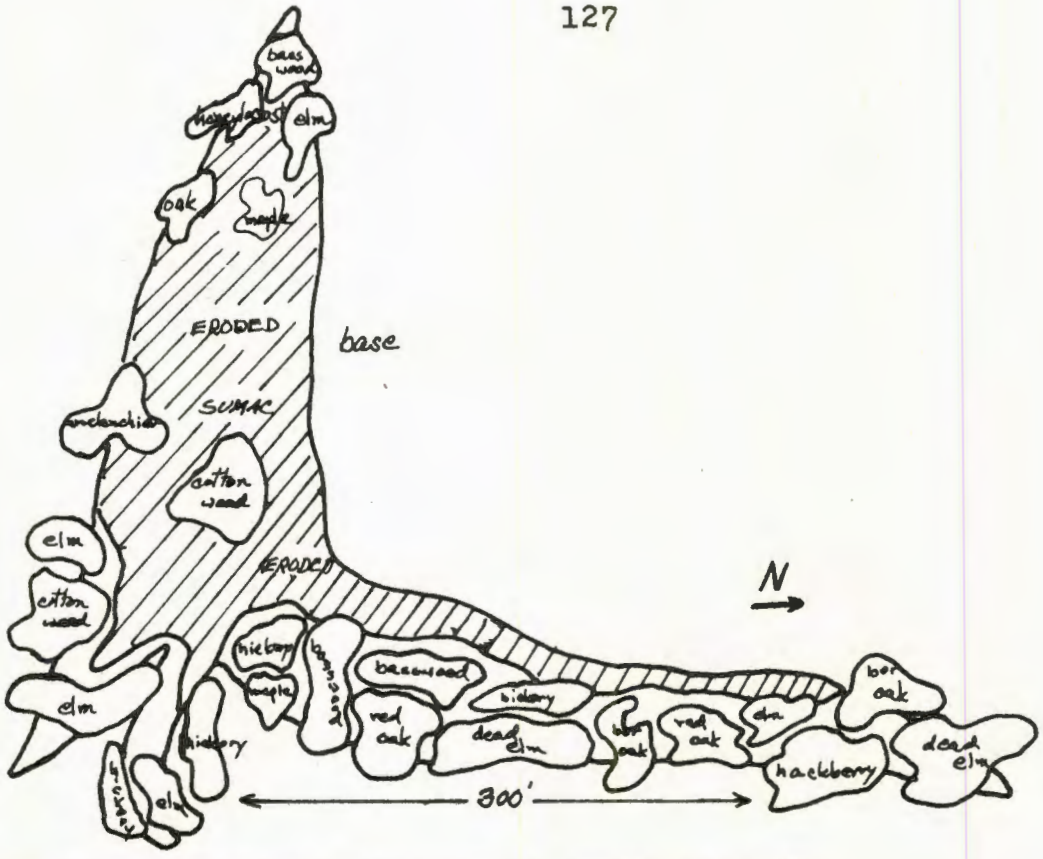



Fig. 84. Schematic diagram of study area 82 approximately 200 feet across and having a vertical length of 500 feet. The unique character of this slope is that the grade is gentle at 20 degrees and may be easily walked in any direction. The surface is not hampered by erosion in any form.

Vegetation is sparse with small honey locust (Gleditsia triacanthos) covering the entire surface. One large shagbark hickory (Carya ovata) is located at center slope near the base and a border of maple (Acer nigrum), bur oak (Quercus macrocarpa) and chinkapin oak (Q. muhlenbergi) line the lower perimeter at Richardson's Branch. The undercover is not diversified, consisting of grasses which completely cover the slope.

This area might have been used as a road from below although no tracks or trails are left as evidence. It is logical, however, that the slope was cleared for some reason, if not only for the wood that once covered the surface.

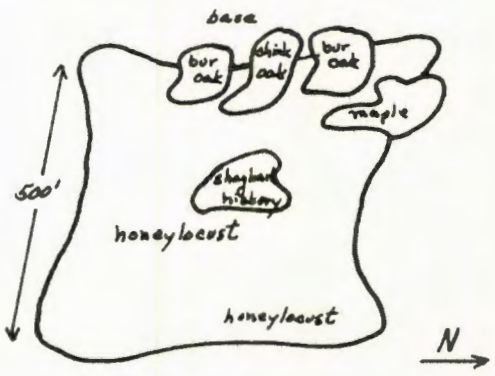



Fig. 85. Schematic diagram of study area 83

Study Area 84

The region designated as Area 84 extends from the south side of Area 83 into a deep ravine extending to the east property line. The area is sloping, and its shallow end extends for 160 feet at the same depth until it reaches the creek. Other sections are much deeper, having a steeper grade. The total length of the slope is approximately 480 feet to a point where a fence marks the neighboring property. The vertical drop of this southerly exposed slope is 140 feet at the deepest point. One section of the surface is exposed to the east, as the gorge turns to the north near the property line.

A farmstead once marked the end of this ravine, and its remains have been pushed into the top end of the gorge. These

remains are not located on arboretum property but are visible from many locations.

Overstory trees cover the slope well with large trees that seem older than specimens found on other slopes. The largest tree found in the entire study area is located near the base th this slope. This large cottonwood (Populus deltoides) reaches far into the sky well above the maples which border the top rim of the slope. There are two communities growing on this slope with an oak-hickory association cominating the south-facing portion of the slope and a maple-basswood association dominating the easterly exposed portion of the slope. Many species are represented here with bur oak (Quercus macrocarpa), red oak (Q. borealis), white oak (Q. alba), chinkapin oak (Q. muhlenbergi), hickory (Carya ovata), black maple (Acer nigrum), basswood (Tilia americana), cottonwood (Populus deltoides) and elm (Ulmus americana) producing a canopy that reduces light reaching the floor to 20 percent.

The understory is dominated by hophornbeam (Ostrya virginiana), which is more dense on shallow portions of the slope. Maple and basswood also grow in the understory, indicating that some changes in dominance may be forthcoming.

Under this mass of canopy, the cover produces a medium carpet of diversified species which stabilize the surface. The vast production of leaves from the trees above forms a

thick mulch over these species making the floor soft and and keeping it moist under the shade of the canopy.

This slope is disturbed less than areas which preceded. A fence located at the top of this slope has prevented cattle from grazing on the foliage produced in the undercover and has preserved the natural appearance of the area.

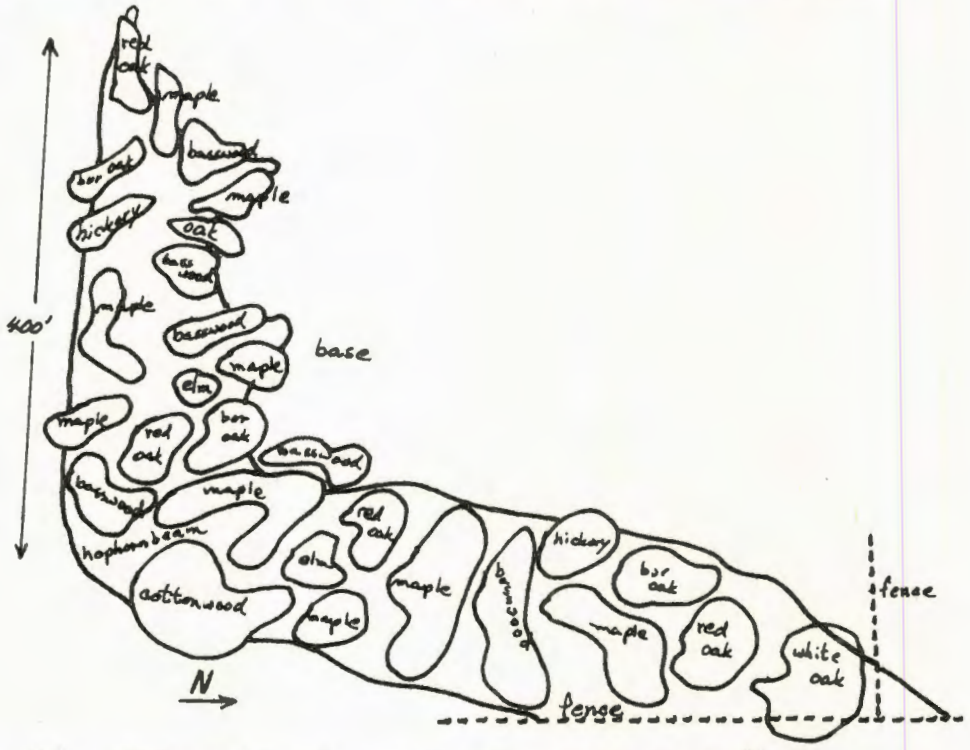



Fig. 86. Schematic diagram of study area 84

Study Area 85

Area 85 forms one wall of a gorge and is opposite Area 86. The areas are located on Fig. 121 in relation to the study area. The deepest section of this slope is cut by the fence which marks the east property line. The length of this area is approximately 400 feet with a vertical drop measuring

100 feet at its deepest point. There is a range in slope from 50 to 70 degrees, being steeper near the base where a section has been eroded by the creek below. The slope is easily walked because of contours left in the formation of the gorge.

Maple (Acer nigrum) and basswood (Tilia americana) dominate the overstory which is best developed on the east end of the slope. Hickory (Carya ovata, C. glabra), bur oak (Quercus macrocarpa), white oak (Q. alba), red oak (Q. borealis) and elm are also part of this canopy that reduces light to 30 percent at the floor.

The understory is dominated by hophornbeam (Ostrya virginiana) which entirely covers the section on the west portion of this slope. Red cedar (Juniperus virginiana) is scattered throughout the understory, and a group of serviceberry plants (Amelanchier canadensis) produce a soft border along the top rim. Maple and basswood are growing in the understory soon to take their place in the canopy above.

The undercover is sparse, due to the excess water moving down the face of the slope. The species present aid in stabilizing the slope and in places are reproducing to form a cover over the entire surface. Litter is also sparse, since water reaches washes it down to the base where it accumulates in pockets of moist, decaying organic material.


Fig. 87. Schematic diagram of study area 85

Study Area 86

Area 86 moves away from the floodplain of Richardson's Branch into a gorge. Its surface forms the north wall of this ravine and is exposed to the south. The slope's length is approximately 250 feet, having a vertical drop of 110 feet at its center. The top ridge of this slope falls gently toward the floodplain, and impressions left by wheels indicate it was once used as a road. The face of this slope is much steeper than its top ridge with a grade ranging from 50 to 70 degrees.

Oak dominates the overstory which completely covers the the slope. Oaks included here are bur (Quercus macrocarpa),

red (Q. borealis), white (Q. alba) and chinkapin (Q. muhlenbergi) with maple (Acer nigrum), shagbark hickory (Carya ovata) and elm (Ulmus americana) adding diversity to the community.

Only hophornbeam (Ostrya virginiana) is found in the understory, and it can only be found on lower portions of the slope. The undercover consists of a limited number of species which cover the slope well. The canopy produces many leaves each year which fall to the surface forming a thick mulch over the entire slope.

This area is of importance, since its top ridge could possibly be used as a trail as development of the property proceeds.

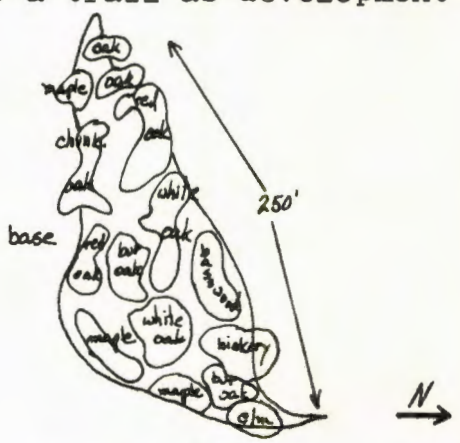



Fig. 88. Schematic diagram of study area 86

Study Area 87

This section of slope increases in depth as it reaches Richardson's Branch. The slope becomes steeper at this point, and its base is eroded by the stream below. Its face is exposed to the north but receives shelter from the adjacent

slope which parallels its surface. The area has a length of approximately 200 feet and a vertical drop of 100 feet at its west end. The grade varies from 40 to 60 degrees as it increases in steepness to the west. There are no trails or contours on its face, making it difficult to maneuver on most sections of the slope.

The overstory is typical of most north-facing slopes because the dominants are maple and basswood (Acer nigrum and Tilia americana). These along with hickory (Carya glabra), white oak (Quercus alba), bur oak (Q. macrocarpa), red oak (Q. borealis) and elm (Ulmus americana) produce a thick canopy which covers 90 percent of the surface. Areas have been disturbed apparently by logging operations, and these sections are beginning to reproduce a similar maple-basswood association. The understory is homogeneous growth of hophornbeam (Ostrya virginiana) with little else except one serviceberry (Amelanchier canadensis) and a few small elms.

The surface is covered well by the groundcover which has recovered from past disturbances on the slope. Although the litter production is heavy, most of this is washed down the slope to form thick pockets of organic matter at the base. Some remains on the surface held by the species in the undercover.


Fig. 89. Schematic diagram of study diagram 87

Study Area 88

This section faces a west-southwest direction as it curves with Richardson's Branch. The north section of slope has a concave shape with a gentle drop through the center. The south end is straight with a steeper grade of 90 degrees at which point its base intersects with Richardson's Branch. The major disturbance here seems to have been timber operations, although time has erased most evidence. The lower portions of the slope are being opened by the death of elm (Ulmus americana) which once formed the canopy. Near the top of center slope, the remains of a cut tree are deteriorating slowly, forming a mound of organic material.

The canopy is dominated by oak (Quercus alba, Q. macrocarpa, Q. muhlenbergi, Q. borealis) with an even mixture of shagbark hickory (Carya ovata), maple (Acer nigrum), hackberry (Celtis occidentalis) and elm. The majority of the trees

are young, giving evidence that the better specimens were removed. These trees are also low-limbed, indicating that much room was available for their growth.

The understory is undeveloped on the northern end of the slope and is represented by a small grove of hophornbeam (Ostrya virginiana) to the south. Serviceberry (Amelanchier canadensis) is also found in the understory with a few species from the overstory.

Under the mass of overstory foliage, the groundcover carpets the entire slope. The cover is thick in response to the open condition left after the removal of trees. The litter produced by the overstory remains under each tree, covering the floor every fall.

The slope is easily walked and is a good place to study the sequence of the replacement of the elm.

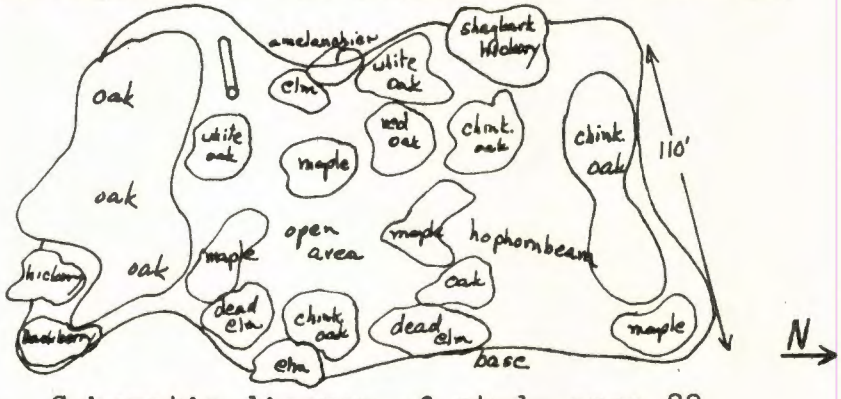



Fig. 90. Schematic diagram of study area 88

Study Area 89

Area 89 turns into a gorge headed in an easterly direction. The east end of this slope is cut by a fence marking

the property boundary. The face of this slope is exposed to the south but receives an extensive shelter from the opposite slope, Area 90. A vertical drop reaches down 110 feet on this slope which is 160 feet long. The grade varies from 50 to 80 degrees being most drastic on the east end.

The overstory is dominated by oak (Quercus alba, Q. macrocarpa, Q. muhlenbergi, Q. borealis)which covers 90 percent of the surface leaving room for one elm (Ulmus americana), two maples (Acer nigrum) and one basswood. The understory includes all of the overstory species with the addition of hophornbeam (Ostrya virginiana) concentrated at the top of the grade. The undercover is well developed covering the slope and stabilizing the surface. This cover provides an anchor for the vast amount of litter produced by overstory trees. These leaves, which are becoming deeper each year, give a soft texture to the surface.

One trail cuts a diagonal across the slope. Its use is primarily for animals but makes an excellent footpath. The overhead clearance is above eight feet leaving no obstructions to the user.

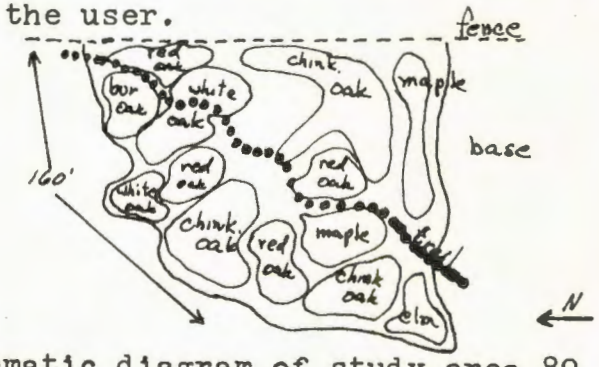



Fig. 91. Schematic diagram of study area 89

Study Area 90

The area returns from the east toward Richardson's Branch. It, like its neighbor Area 89, is short and protected by the close proximity of the opposite slope. The slope extends down 110 feet to a rock-bottom stream flowing from neighboring fields to the east. The grade drops in two directions as its face falls to the north and to the west with a 90-degree slope.

The vegetation is dominated by maple and basswood (Tilia americana) which form the greatest portion of the canopy. Oak (Quercus borealis, Q. muhlenbergi) also grows here in fewer numbers. The overstory population is young leaving the slope open with 40 percent of direct light reaching the floor. This quantity of light increases the production in both the understory and undercover. Hophornbeam dominates the lower strata, forming a grove effect at center slope. The undercover carpets the slope, holding the soil to this steep surface. Most of the litter produced can be found near the base in thick deposits.

One trail transverses half the slope to a point where the terrain is too steep for such maneuvers.

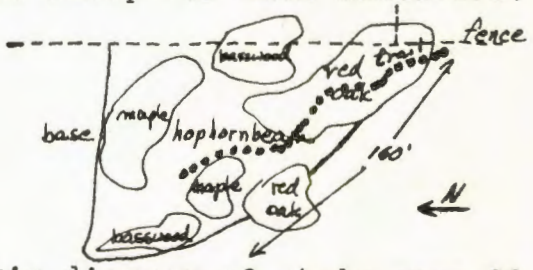



Fig. 92. Schematic diagram of study area 90

Study Area 91

Area 91 is adjacent to Richardson's floodplain and is exposed to the west. The southern end of this slope turns to expose its surface to the north. The surface is disturbed in two places by erosion which seems to be arrested and stabilized by a developing groundcover. This slope, like others in the area, is steep with a grade averaging 90 degrees down its surface. This area is approximately 400 feet long with a vertical drop of 180 feet. The slope is difficult to walk and is best viewed from the top ridge or the floodplain below.

Vegetation in the overstory consists of a mixture of oak, basswood and maple, dominated by oak species scattered over the entire slope. Species included here are red oak (Quercus borealis), bur oak (Quercus macrocarpa), chinkapin oak (Quercus muhlenbergi), basswood (Tilia americana), honey locust (Gleditsia triacanthos), shagbark hickory (Carya ovata), red mulberry (Morus rubra), elm (Ulmus americana), pignut hickory (Carya glabra) and butternut. The understory contains only hophornbeam and red cedar (Ostrya virginiana and Juniperus virginiana) found in groves across the surface. The undercover is well established, except in eroded areas where vegetation was removed. Litter falls down the slope to accumulate near the base and forms deep layers of organic material.

The southern ridge forms a gentle slope suitable for walking. Areas near the base are blocked by the remains of fallen trees uprooted by the wind. This slope is easier to view than to walk upon.

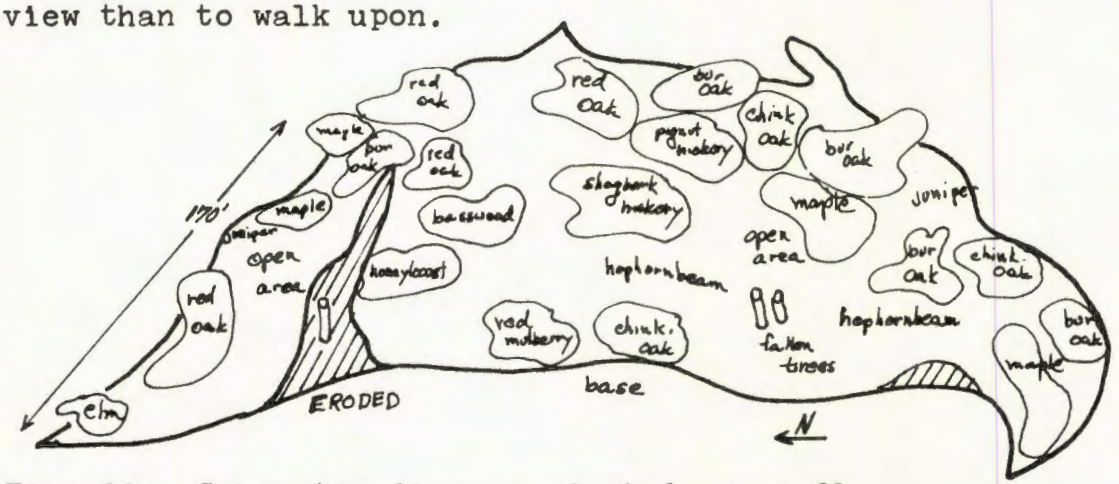



Fig. 93. Schematic diagram of study area 91

Study Area 92

The slope studied as Area 92 is exposed to the southwest and is adjacent to the floodplain of Richardson's Branch. A fence intersects its top rim, as a monument between two 40-acre sections. Its surface has a grade averaging 60 degrees and a vertical drop of 160 feet. Its length stretches approximately 450 feet with a shifting surface of small gorges, reducing its maneuverability.

Oaks dominate the canopy which covers 80 percent of the surface, reducing light to 30 percent. Red oak (Quercus borealis), chinkapin oak (Q. muhlenbergi), bur oak (Q. macrocarpa), shagbark hickory (Carya ovata), black maple (Acer nigrum), butternut (Juglans cinerea), basswood (Tilia americana)

elm (Ulmus americana) and honey locust (Gleditsia triacanthos) produce this diversified community of overstory trees. The species are scattered homogeneously over the entire slope with few openings left by the death of elms.

The understory is only developed in open areas and consists mainly of hophornbeam (Ostrya virginia) and juniper. The groundcover is developed but shows evidence of disturbance by grazing. The undercover is dominated by grass and contains only a few of the woody species from the overstory.

The surface is difficult to walk and is best viewed from the surface above the slope or the floodplain below.

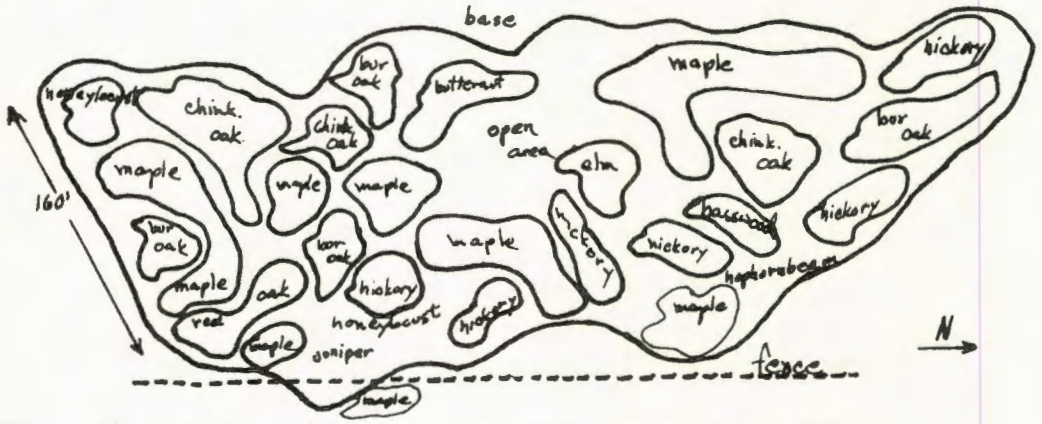



Fig. 94. Schematic diagram of study area 92

Study Area 93

Area 93 is part of a secondary drainage gorge which turns to the east and exposes its surface to the south. The lower portion of this slope is severely eroded, leaving only 40 percent of the surface undisturbed and supporting vegetation. The length of this section is approximately 400 feet

with a vertical drop of 180 feet. Sections not eroded are steep with a grade averaging 80 degrees.

The canopy is 90 percent oak (Quercus alba, Q. borealis, Q. macrocarpa, Q. muhlenbergi) with maple (Acer nigrum), ash (Fraxinus americana), hickory (Carya ovata), basswood (Tilia americana) and elm (Ulmus americana) covering small areas in limited numbers. Overstory trees are concentrated near the top ridge, acting as umbrellas over the lower portions. The understory is well developed containing many oak and maple with hophornbeam (Ostrya virginiana) and juniper supporting their dominance. The undercover is sparse but manages to hold the surface intact. Litter falls to the base where it is washed toward Richardson's Branch.

The area is unstable, since the erosion at the base has not been arrested and continues slowly to erode more surface. Most of the area will not be usable until measures to correct this disturbance are taken.

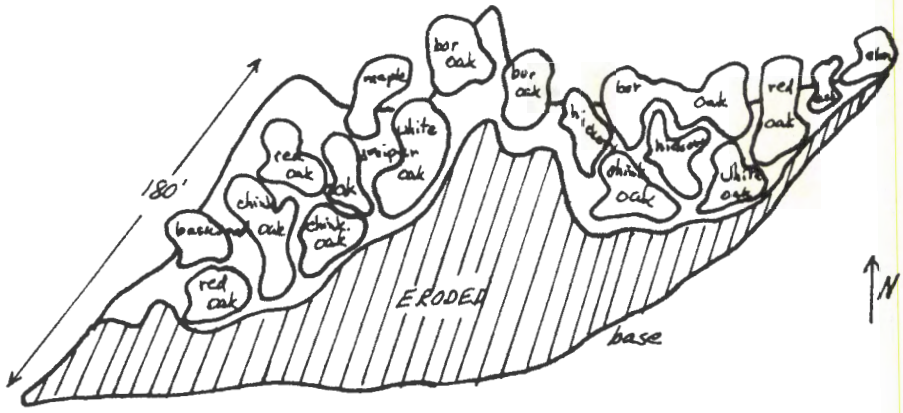



Fig. 95. Schematic diagram of study area 93

Study Area 94

The surface of this area is exposed to the north as it forms the south wall of the gorge. Its length is approximately 300 feet with a vertical drop of 180 feet at a point where it reaches down to Richardson's Branch. The surface is sloped with a grade averaging 60 degrees and is steepest at its shallow end. The base of this slope is not eroded as its neighbor, since the curvature of the stream below forces water against the opposite slope rather than the surface of Area 94.

A canopy of oak (Quercus borealis, Q. muhlenbergi, Q. macrocarpa), maple (Acer nigrum), bitternut (Juglans cinera), basswood (Tilia americana) and ash (Fraxinus pennsylvanica lanceolata) covers 80 percent of the surface reducing light to 30 percent. The dominance is held by oak and maple which grow in groups at either end of the slope. The understory is represented only by hophornbeam (Ostrya virginiana) which form dense communities in open areas of the slope. The undercover is well developed and diversified unlike most of the other areas.

The surface seems to have been spared the disturbances of grazing and lumbering. The slope is walkable with a soft feeling produced by the mulch of litter collected on the surface.

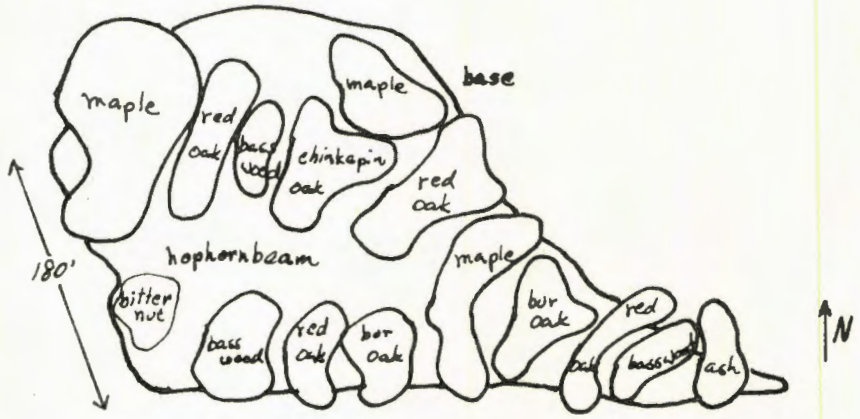



Fig. 96. Schematic diagram of study area 94

Study Area 95

The section designated as Area 95 is adjacent to Richardson's Branch. Its surface is exposed to the northwest on the north and to the southwest on its southern end. The center portion has been severely eroded by the action of the creek below, and its devastation continues with each surge of high water. At two points, the battered remains of fences are left strewn over the landscape. Their purpose seems to have been a barrier to grazing animals. The northern extreme of this slope is the least disturbed region east of Richardson's Branch. This might be attributed to the prevention of grazing in the past. Species are found in a cycle ranging from the undercover to the overstory on all levels of the slope. Area 95 is approximately 425 feet long with a vertical drop of 190 feet. The slope ranges from 70 to 90 degrees being more severe down eroded areas.

The overstory is divided into two associations dominated by oak on higher levels and by maple toward the base. A number of species can be found here including red oak (Quercus borealis), bur oak (Q. macrocarpa), chinkapin oak (Q. muhlenbergi) white oak (Q. alba), black walnut (Juglans nigra), shagbark hickory (Carya ovata), basswood (Tilia americana), black maple (Acer nigrum), elm (Ulmus americana), honey locust (Gleditsia triacanthos) and serviceberry (Amelanchier canadensis).

The understory is well developed containing most of the species found overhead. In addition, hophornbeam (Ostrya virginiana) and red cedar (Juniperus virgininiana) are grow ing in association with the other species. The undercover is well developed to the north but deteriorates as the slope is traveled south. It is apparent that sections to the south were exposed to grazing and disturbed by the practice.

The slope is steep but walkable if one follows contours etched in its surface by water moving down the surface. Litter accumulates on these sites, producing a carpet of soft organic deposits.

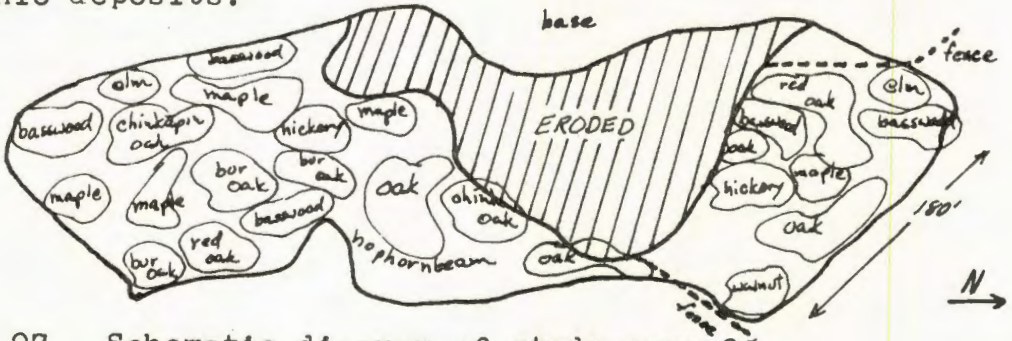



Fig. 97. Schematic diagram of study area 95

Study Area 96

This southerly exposed slope measures 400 feet in length with a vertical drop of 180 feet. The surface has a grade ranging from 50 to 70 degrees having a greater incline on its eastern edge. Soil is exposed over 50 percent of the area and continues to move down its face. Vegetation is sparse in all strata, especially in the undercover. This situation is the result of poor management in the past when the slope was used to graze animals. The slope's base is bordered by a community of dead elm, leaving its lower portions without a canopy.

The sparse overstory is dominated by oak (Quercus muhlenbergi, Q. macrocarpa, Q. borealis) with a few specimens of maple (Acer nigrum), elm (Ulmus americana), honey locust (Gleditsia triacanthos) and hickory (Carya ovata, C. glabra). Many of these trees have high-branching habits, which indicate that they were grown under crowded conditions. Those which populate the lower portions of the slope have lower branches, indicating their development was under open conditions.

The only understory specie is Juniper, which is concentrated in a small area near the slope's top rim. These plants may have been planted, but no evidence exists to support this idea. The undercover is surprisingly sparse when one considers the vast amount of light reaching the floor. The

disturbance by erosion surpasses its development and may be the major cause of its sparseness.

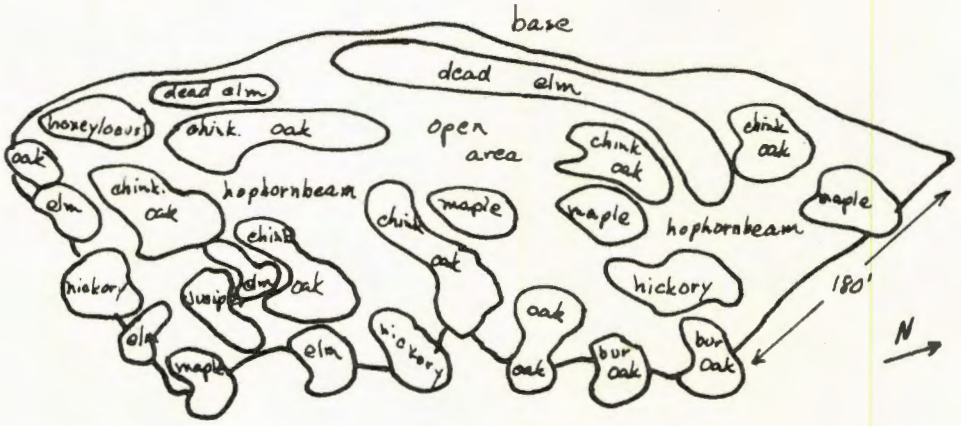



Fig. 98. Schematic diagram of study area 96

Study Area 97

The section represented by Area 97 is part of a small drainage gorge, extending from the floodplain in a northerly direction. The surface is approximately 230 feet long with a vertical drop of 170 feet at its deepest point.

Exposure is to the southeast, supporting a canopy of oak (Quercus macrocarpa, Q. muhlenbergi, Q. borealis), maple (Acer nigrum) and elm (Ulmus americana). The dominance is held by oak concentrated on higher levels. The canopy is sparse leaving large openings which allow much light to reach the surface. Lacking an understory, the slope gives an open feeling, since the trees are high-branched and widely spaced. The undercover has developed on portions of the surface concentrated on surfaces not covered by the canopy. Other sections are left exposed and are subject to erosion with each

rain. Litter can only be found near the base where it accumulates after a flight down the face of the slope.

The slope is of little value as a natural area, since it lacks many stages of development and diversity.

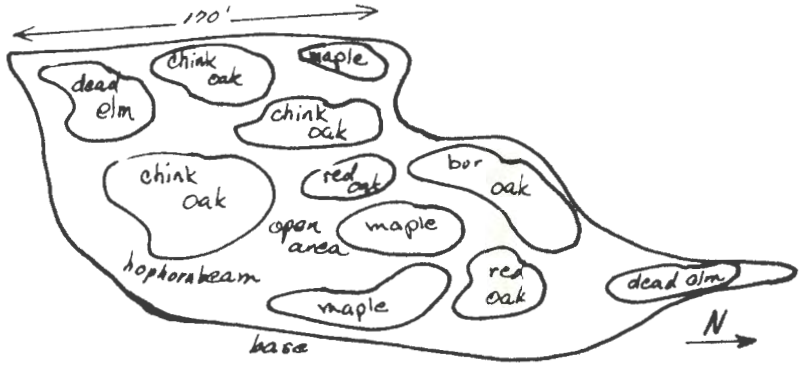



Fig. 99. Schematic diagram of study area 97

Study Area 98

Area 98 is a slender section of slope bordering a gorge which drains into Richardson's Branch. The slope reaches a maximum depth of 130 feet at its center, tapering in both directions from that point. The surface is exposed to the northwest with a grade averaging 70 degrees. The slope is difficult to walk and best observed from the surface above the slope.

Vegetation is undergoing disturbances caused by the death of elm which once covered 30 percent of the slope. The remaining canopy is dominated by Oak (Quercus muhlenbergi, Q. borealis, Q. macrocarpa) and supported by hickory (Carya ovata, C. glabra), basswood (Tilia americana) and maple (Acer nigrum). Understory vegetation is sparse, containing only hophornbeam (Ostrya virginiana) and red cedar (Juniperus

virginiana). The surface has been washed by rain, since the loss of overhead protection. This situation leaves the undercover devastated over 60 percent of the surface.

The slope is of little value as a nature preserve but is an excellent area to study succession of vegetation following the death of elm. This may become of value with their increasing deaths across the region.


Fig. 100. Schematic diagram of study area 98

Study Area 99

The section studied as Area 99 is a gentle slope, averaging a grade of 30 degrees. The overstory vegetation has been cut leaving only six trees over the entire area. Many of the trees remain in the original positions in which they fell, littering the slope with large trunks and branches. The slope provides an excellent area to walk to from the flood-plain below.

Trees remaining include black maple (Acer nigrum), bur oak (Quercus macrocarpa), hackberry (Celtis occidentalis) and honey locust (Gleditsia triacanthos). There is no understory,

and the cover is provided by a carpet of grass over the entire slope.

The area has potential as a roadway to the floodplain and as an outlook provided by the view of the valley to the south.

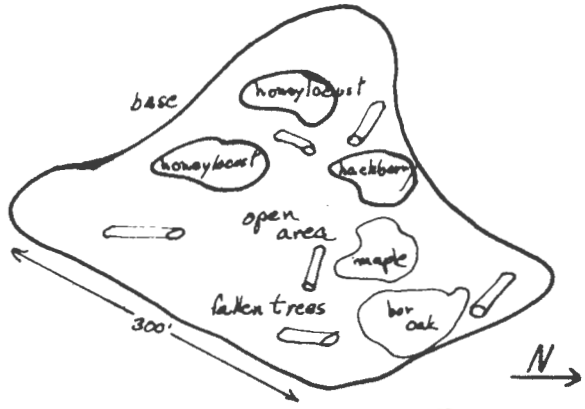



Fig. 101. Schematic diagram of study area 99

Study Area 100

The section studied as area 100 branches into a long gorge exposed to the south and southwest. Its surface averages a grade of 70 degrees with the most extreme part near an eroded section at the base. During the formation of this gorge, contours were cut as the stream dug deep channels down to rock below. These contours are excellent for walking and might be used as trails in the future. The slope's length is approximately 450 feet with a vertical drop of 180 feet at its deepest point.

The overstory is a mixed association of oak, maple and hickory. The species included in the area are bur oak (Quercus macrocarpa), chinkapin oak (Q. muhlenbergi), red oak

Q. borealis), white oak (Q. alba), basswood (Tilia americana), black maple (Acer nigrum), shagbark hickory (Carya ovata), honey locust (Gleditsia triacanthos) and elm (Ulmus ameri- These trees are densely planted and concentrated along the center of the slope. There are few overstory trees at the base of the slope, but canopy is provided for this area by the trees from above.

Understory is absent on the western end of the slope and sparse toward the east. Juniper is the only species represented in any numbers with a few species from the overstory reproducing themselves in this strata.

The undercover is dense over the entire slope except for the eroded areas at the base. This cover stabilizes the surface and helps to retain the litter produced by the canopy. Deep accumulations of litter have formed at various places on the surface, producing cushions of organic deposits.

Area 100 is interesting and should be retained as a study area of this oak-maple-hickory association which is common in central Iowa. Measures should be taken to correct the eroded conditions along the west base of this slope.

Study Area 101

Area 101 is a sloping surface that forms the east wall of a gorge that drains the farm land above. Its surface is approximately 300 feet long, and its vertical drop reaches 150 feet at its deepest point. The grade averages 70 degrees,

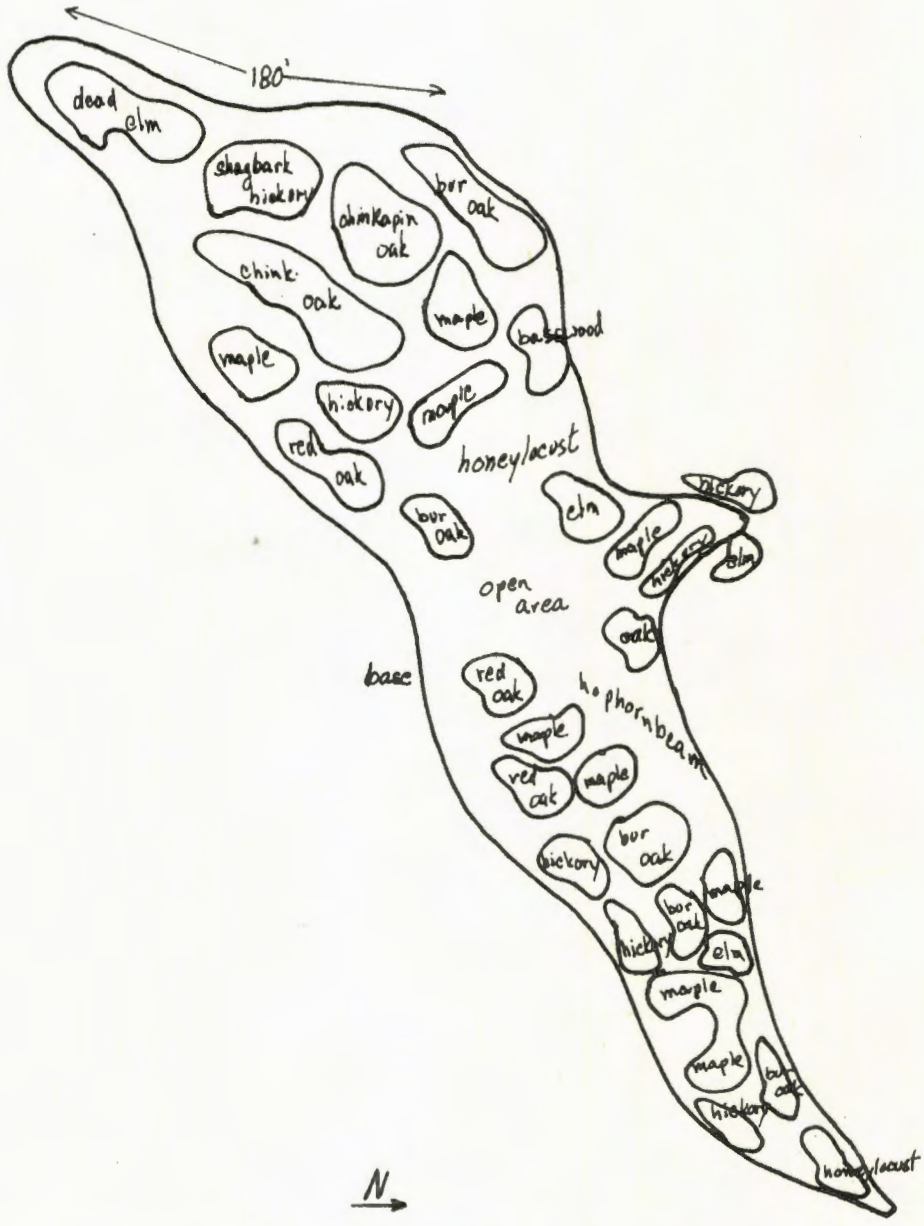



Fig. 102. Schematic diagrem of study area 100

increasing near the base where erosion has eaten into the surface. One gentle grade is formed at the west end of the slope as it turns into a second gorge. This section is useful as a trail down the slope.

Dominance in the overstory is shared by maple and oak. The community includes black maple (Acer nigrum), red oak (Quercus borealis), shagbark hickory (Carya ovata, pignut hickory (C. glabra), honey locust (Gleditsia triacanthos), basswood (Tilia americana) and elm (Ulmus americana). This canopy covers 90 percent of the surface, reducing light to 20 percent in the undercover. The understory is only represented by red cedar (Juniperus virginiana) sparsely distributed over the surface. The undercover is well developed securing the surface as well as the litter which falls from above.

Vegetation is stable on this slope and faces only minor disturbance from erosion and dying elms at its base.

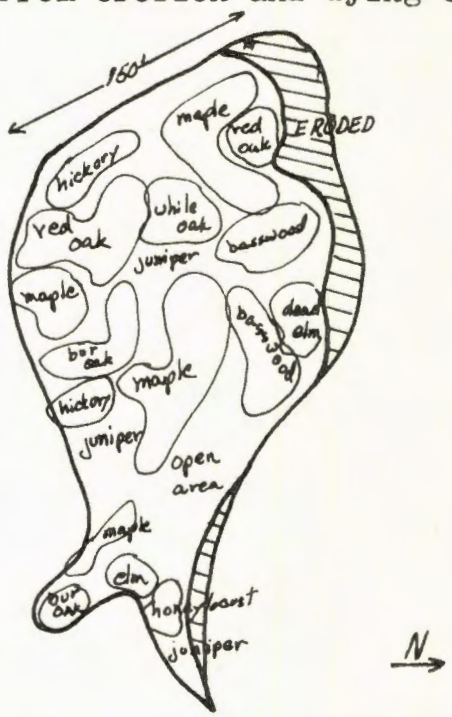



Fig. 103. Schematic diagram of study area 101

Study Area 102

This southerly exposed slope is dominated by maple. The canopy includes black maple (Acer nigrum), chinkapin oak (Quercus muhlenbergi), bur oak (Q. macrocarpa, shagbark hickory (Carya ovata), red oak (Q. borealis) and elm (Ulmus americana). This overstory covers 60 percent of the surface with a dense shade eliminating most of the direct light. The understory includes three species: hophornbeam (Ostrya virginiana), red cedar (Juniperus virginiana) and maple. They are concentrated in an open area at center slope. The undercover is sparse, leaving soil exposed over much of the surface.

The area is approximately 250 feet long with a vertical drop of 150 feet at its deep end. An average grade of 60 degrees makes the surface difficult to walk upon. There are no trails, making it more difficult to maneuver over this slope.

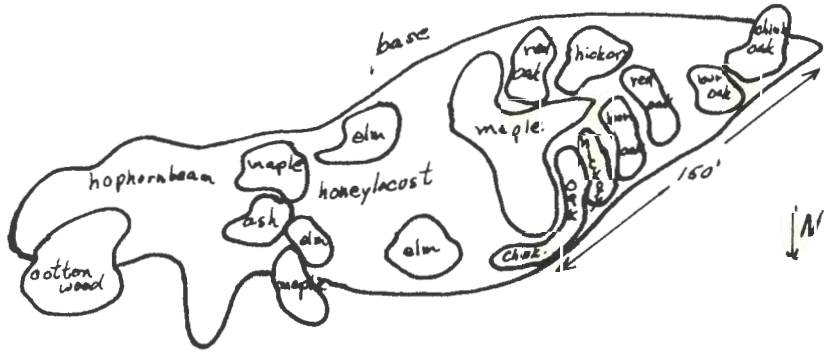



Fig. 104. Schematic diagram of study area 102

Study Area 103

Study Area 103 is a disturbed section of sloping surface extending from Richardson's Branch into a gorge to the east. Its surface is exposed to the north with little shelter provided by the sparse canopy. The creek below has eroded much of the base, leaving exposed soil susceptible to further erosion. A severe problem has developed with the death of several elms which once dominated portions of the overstory. Areas beneath these trees have been exposed to elements which have removed most of the cover leaving an unstable surface. The remaining trees are concentrated on the top edge with canopies that shelter the slope below.

The overstory is dominated by maple (Acer nigrum) with the addition of one shagbark hickory (Carya ovata). Hophornbeam (Ostrya virginiana) and red cedar (Juniperus virginiana) which share the understory. Juniper is concentrated under the maples along the top rim. The ground cover is sparse and left unstable by disturbances. It is best developed on the top half of the slope where it is mulched by litter produced in the canopy.

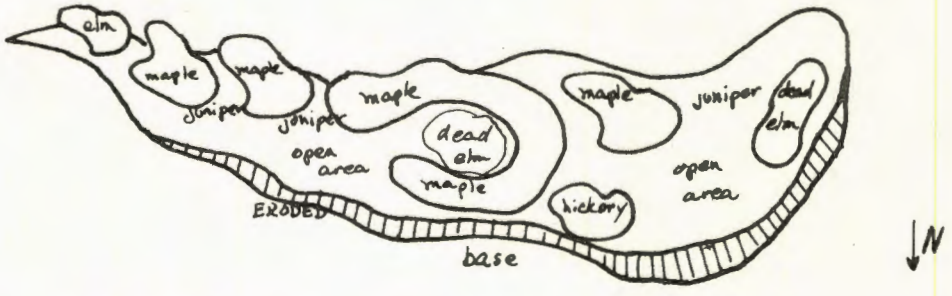



Fig. 105. Schematic diagram of study area 103

Study Area 104

A portion of Area 104 was once used as a road to carry coal and logs from the floodplain below. The road remains neglected and is in poor condition. A fence lines each side of the road with a dense population of trees and shrubs growing through the strands of wire. The area north of the road seems to have been disturbed during construction and remains barren. South of this area, a dense planting of overstory trees provides a canopy camouflaging the road below.

The overstory is dominated by a mixture of oak and maple species. Chinkapin oak (Quercus muhlenbergi), red oak (Q. borealis), white oak (Q. alba), bur oak (Q. macrocarpa), black maple (Acer nigrum), shagbark hickory (Carya ovata), pignut hickory (C. glabra), basswood (Tilia americana), hackberry (Celtis occidentalis), honey locust (Gleditsia triacanthos) and elm (Ulmus americana) produce a dense canopy over the south end of the surface. The understory contains hophornbeam (Ostrya virginiana) and many species from the overstory. Red cedar also appears in this strata and is the only woody material on the north end of the slope. The ground cover is thick stabilizing the surface which was once eroded as a roadbed.

This westerly exposed slope is of importance as an overlook as well as its potential for transportation use in both directions.


Fig. 106. Schematic diagram of study area 104

Study Area 105

This area consists of a double-branched concave slope in a very disturbed condition. The surface is approximately 400 feet long with a vertical drop of 180 feet. Many trees have been uprooted and are strewn across the surface as mounds of decaying organic material. Remaining trees form slender trunks as they surge up in search of light. The ground is damp with a vast amount of litter mulching the surface. The undercover is sparse, leaving much of the area covered only by leaves.

The slope is easily walked, since the grade averages 30 to 40 degrees to the floodplain below. This area represents the densest planting of woody species in the entire study area. There also seem to be some water sources underground that keep the slope moist and capable of supporting such dense vegetation.

Species included are cottonwood (Populus deltoides), elm (Ulmus americana), shagbark hickory (Carya ovata), pignut hickory (C. glabra), white oak (Quercus alba), bur oak (Q. macrocarpa), serviceberry (Amelanchier canadensis), and hophornbeam (Ostrya virginiana). These trees are randomly scattered over the entire area.


Fig. 107. Schematic diagram of study area 105

Study Area 106

Area 106 is a large round-faced slope exposed to the south and adjacent to the floodplain of Richardson's Branch. The slope's length is approximately 300 feet with a vertical drop of 190 feet. A 50-degree grade makes the surface steep and difficult to walk upon.

A dense population of trees produces an overstory that reduces light to 10 percent on the surface. These trees are high-branched with slender trunks competing for height advantages. The absence of understory gives an aesthetic view of textured trunks along the entire length of the slope. Ground cover is sparse but well diversified under this dense canopy.

The species in this strata begin growing before the leaves of the overstory can shade the sun from their foliage and slowly retire in the summer shade.

The canopy is dominated by oak and is an excellent example of an oak-hickory association. Species included in the overstory are red oak (Quercus borealis), chinkapin oak (Q. muhlenbergi), bur oak (Q. macrocarpa), pignut hickory (Carya glabra), maple (Acer nigrum), elm (Ulmus americana), basswood (Tilia americana), boxelder (Acer negundo), serviceberry (Amelanchier canadensis), cottonwood (Populus deltoides) and hophornbeam (Ostrya virginiana). These species grow inches apart to produce the densest association in the study area.

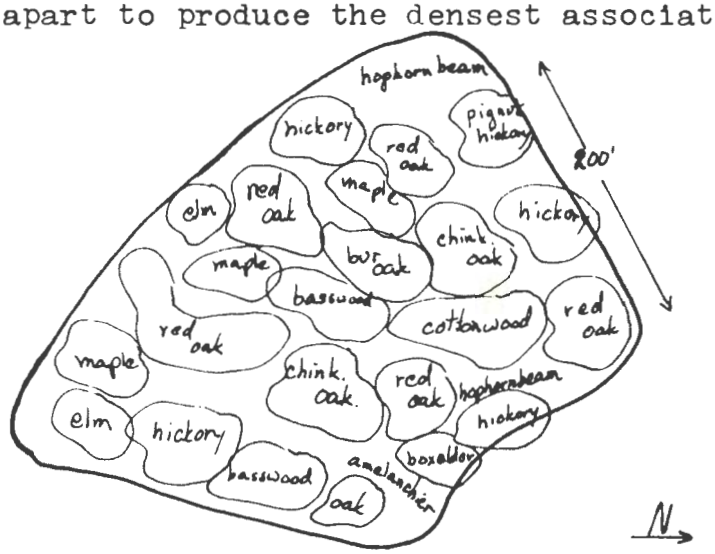



Fig. 108. Schematic diagram of study area 106

Study Area 107

Area 107 forms one wall of a gorge that extends to the north and exposes the area to the east. The slope is approximately 500 feet long and has a vertical drop of 190 feet at

its deepest end. The grade varies from 60 to 80 degrees on stable surfaces and has a 90-degree slope over an eroded base. The diversity of the overstory and the stability of the undercover indicates that the slope was spared from disturbances such as grazing or lumbering. The only trails here are faint, wild animal tracks observed in all directions. A fence was erected near the shallow end of the slope and identifies the edge of a 40-acre section.

The overstory is complex, if individual species are considered and understood as two associations. The higher portions of the slope are dominated by oak and are characteristic of an oak-hickory association. Lower portions are dominated by maple and basswood. These associations intermingle at points, producing an interesting study area. Species included in the overstory are red oak (Quercus borealis), chinkapin oak (Q. muhlenbergi), bur oak (Q. macrocarpa, white oak (Q. alba), black maple (Acer nigrum), basswood (Tilia americana), shagbark hickory (Carya ovata), pignut hickory (C. glabra), cottonwood (Populus deltoides), ash (Fraxinus pennsylvanica lanceolata), elm (Ulmus americana), and boxelder (Acer negundo). This population is supported by an understory dominated by hophornbeam (Ostrya virginiana) and includes many of the species in the overstory.

Undercover species and litter cover the entire surface. Growth in this strata is limited by the reduced light and

density of overstory species. The litter forms mats over bare areas, protecting them from the elements.

The only disturbance on this slope has been the erosion of sections along the base. This seems to have increased in recent years with the cultivation of flat surfaces above allowing a greater runoff through this gorge.

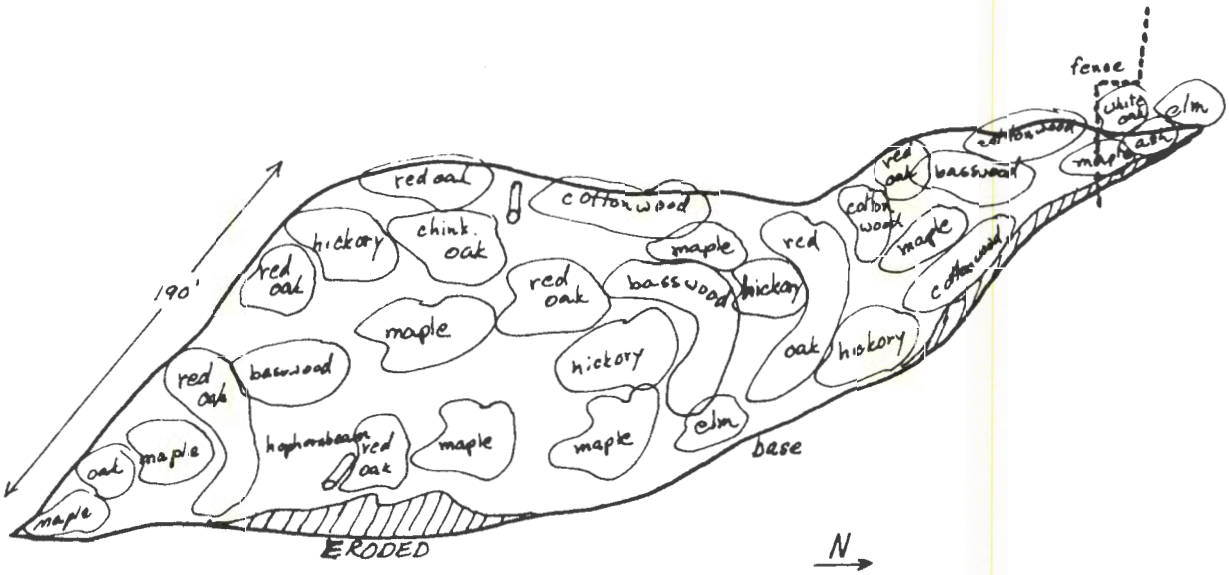



Fig. 109. Schematic diagram of study area 107

Study Area 108

The east side of this deep gorge will be considered Area 108. Its length is approximately 500 feet with a vertical drop of 190 feet along its southern end. The surface is exposed to the west and is sheltered by a neighboring slope, Area 109. Its surface has an average grade of 80 degrees and is less severe on one ridge of its southern end.

At one time, a house stood above this slope, and its remains have been pushed down its face. Stone, metal and wood

of all shapes can be found where the avalanche of civilization of civilization came to rest over the understory. A fence remains as a landmark strung out in two directions from the structure site. These remains are camouflaged by vegetation and can only be observed at close range.

The shallow end of this area lacks an overstory with the death of a large group of elm. The remaining area is well covered by an overstory dominated by oak and supported by a mixture of other species. The canopy includes red oak (Quercus borealis), bur oak (Q. macrocarpa), chinkapin oak (Q. muhlenbergi), maple (Acer nigrum), basswood (Tilia americana), shagbark hickory (Carya ovata), pignut hickory (C. glabra), boxelder (Acer negundo), elm (Ulmus americana), serviceberry (Amelanchier canadensis) and weeping willow (Salix babylonica). Light is reduced 80 percent under the understory.

Understory species include oak, maple, hickory and elm, dominated by hophornbeam (Ostrya virginiana) at all levels. The overstory species are well represented as their next generation begins to compete for an opening in the canopy. They are also represented in the undercover as seedlings push through the dense mulch of litter produced by the overstory and left to deteriorate on the surface. The herbaceous layer is diversified and well represented under the dense cover.

The slope is an excellent natural area, except for the small section at its shallow end disturbed by dying elm and remains of an old building.

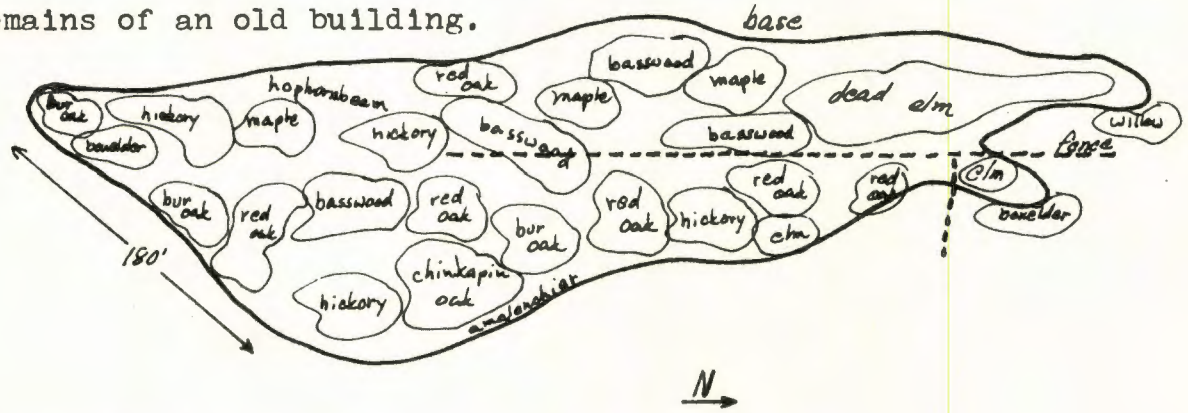



Fig. 110. Schematic diagram of study area 108

Study Area 109

Richardson's Branch is joined at this point by a creek flowing from the east. Area 109 faces the junction and is exposed to the southwest. The surface was subject to erosion from both creeks, producing odd formations on its face. The area is stabilized by vegetation growing over the ridges formed across the surface. The area is approximately 300 feet wide with a vertical drop of 200 feet and a varying grade from 30 to 90 degrees.

The overstory is dominated by oak (Quercus alba, Q. muhlenbergi, Q. macrocarpa, Q. borealis) with maple (Acer nigrum), basswood (Tilia americana), hickory (Carya ovata) and elm (Ulmus americana) completing the dense cover. Trees in the overstory are randomly spaced over the surface and seldom do two similar species neighbor each other.

An understory dominated by hophornbeam (Ostrya virginina) is best developed at center slope. Few of the overstory species are found in this strata, indicating that changes may take place should they fail to reproduce. The understory includes Amelanchier which stands a a monument at the top of this slope.

Under these masses of foliage, which reduce light reaching the floor, is a sparse undercover. It covers only 30 percent of the surface locating mainly on the gentle-sloped areas. Litter covers the entire slope with a thick layer of dried leaves building a highly organic surface.

This area is unique because of formations on its surface and should remain as a study area of the oak-hickory association. The highest portions of the slope might also be used as an overlook, if a portion of the canopy is removed from obstructing the view. Its merit for this use might be judged during winter months when leaves have fallen from the canopy.


Fig. 111. Schematic diagram of study area 109

Study Area 110

Area 110 is a large slope with portions exposed to every direction as it swerves into ravines and out of large eroded gorges in its face. The area is approximately 700 feet long having a vertical drop of 220 feet to the stream below. A number of disturbances have caused the slope to appear as it does today. The west side of this area is scarred by a long incline extending from the base to its highest level. Trees on both sides of this incline are small, indicating that they have replaced trees which were removed. The incline was probably used to drag material,either wood or coal, from the base. This belief is supported by the remains of a building rampart on the top of the slope. The incline leads to this area where a mound was constructed to ease the burden of loading operations. The center and eastern portions of this area are eroded by the stream below and excess water from above. As land was put into cultivation, the topography of the area allowed excess water to converge at a point near center slope. The forces managed to erode slivers of soil until it formed a small gorge parallel to the face of the slope, leaving a ridge of soil to the south. The area is still unstable and free of vegetation. Another section is eroded by the stream, leaving unsupported earth dangerously hanging at higher levels.

The overstory varies from dense oak-dominated communities on undisturbed surfaces to young communities of honey

locust and hophornbeam. This canopy includes a number of species, and all communities show a tendency to be dominated by oak. Red oak (Quercus borealis), chinkapin oak (Q. muhlenbergi), white oak (Q. alba), black maple (Acer nigrum), basswood (Tilia americana), cottonwood (Populus deltoides), elm (Ulmus americana), hackberry (Celtis occidentalis), hickory (Carya ovata), honey locust (Gleditsia triacanthos) and sumac (Rhus glabra) are included in this varying overstory. The understory is randomly scattered over the surface and is beginning to cover many of the cleared areas. Species included here are red cedar (Juniperus virginiana), hophornbeam (Ostrya virginiana) and sumac with most of the overstory species reproducing in this strata.

The ground cover varies from a dense mat under undisturbed areas to bare surface over eroded areas. There are few woody species in the cover and little litter. Most of the litter produced is washed or blown from the surface.

Area 110 should be stabilized before use can be made of it as a study area. The surface is too steep for walking, except down the incline to the west.

Study Area 111

Area 111 consists of an unusually long slope exposed to the east. Its length extends 1400 feet, making it the largest single study area considered. The vertical drop down its face extends 190 feet to a big area at its base. A varying


Fig. 112. Schematic diagram of study area 110

grade from 50 to 90 degrees moves down a rounded surface formed by smaller intrusions in the surface. The vegetation on this slope seems undisturbed by grazing or logging. Many large walnut trees exist untouched by the woodsman's axe. The undercover contains herbaceous species in great quantity as compared to other surfaces in the area. Animal trails are

numerous on the surface in every direction. Most trails are narrow with low-hanging limbs obstructing the path. Few would be usable because of their limited width. The southern end of the area is unstable and eroded. Forces from the stream eat into its base causing unsupported soil from above to roll into the water below.

The overstory is produced by a number of species dominated by oak. The association is a mixture of the oak-hickory and maple-basswood common to the area. The species in the understory and undercover indicate that the maple and basswood may gain dominance in future years. Red oak (Quercus borealis), chinkapin oak (Q. muhlenbergi), bur oak (Q. macrocarpa), shagbark hickory (Carya ovata), black walnut (Juglans nigra), black maple (Acer nigrum), basswood (Tilia americana), green ash (Fraxinus pennsylvanica lanceolata), willow (Salix nigra), serviceberry (Amelanchier canadensis) and elm (Ulmus americana) are included randomly through the canopy. A number of elm have died, leaving openings in the canopy which have resulted in increased growth of understory species.

An understory dominated by hophornbeam (Ostrya virginiana) and including most of the overstory species is concentrated over the top half of the slope. Lower portions have little understory due to moist conditions that support only willow. The undercover is well developed over most of the surface, except for a disturbed area toward the north end.

At this point, the surface is washed by excess water from above, preventing the establishment of cover. The steepness of the surface makes litter accumulation difficult, since most is washed to the base and deposited to form deep organic mats.

The old fence which borders the slope's top rim is an excellent vantage point for viewing this slope. Objects such as old automobile bodies and abandoned land levelers litter the top rim of this area. This area would be wisely left to develop as a nature area.

Study Area 112

The section studied as Area 112 is a convex sideslope that is part of a secondary drainage gorge. Its surface is exposed to the north and erosion is common on 30 percent of the area. The grade establishes an 80-degree slope making its surface undesirable for footpaths. A fence cuts through the eastern end of the slope, leaving strands of barbed wire strewn over the surface. An automobile body was placed at the head of the slope to prevent erosion, and fenders with other parts are left over the top edge.

The overstory is dominated by maple (Acer nigrum) and supported by basswood (Tilia americana), red oak (Quercus borealis), chinkapin oak (Q. muhlenbergi), willow (Salix nigra), cottonwood (Populus deltoides), elm (Ulmus americana)

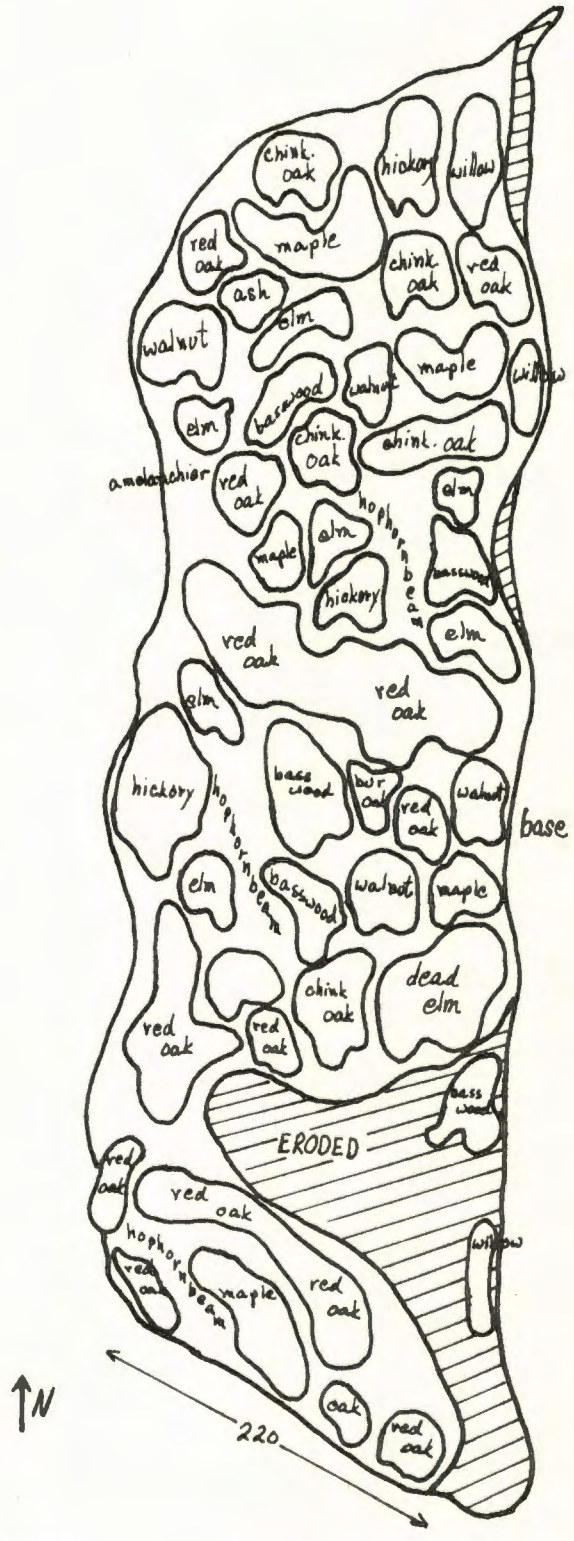



Fig. 113. Schematic diagram of study area 111

and pignut hickory (Carya glabra). The canopy reduces light reaching the floor to 30 percent. Understory species are limited to hophornbeam (Ostrya virginiana) and maple concentrated at center slope. These produce a dense arrangement of small trunks, obstructing vision across the slope. The understory is sparse and severely washed from above. Litter does not accumulate on the surface but is washed to the base where it forms deep deposits.

This area is disturbed and will require stabilization before it can be used. The association is not unique, limiting the value of the area.

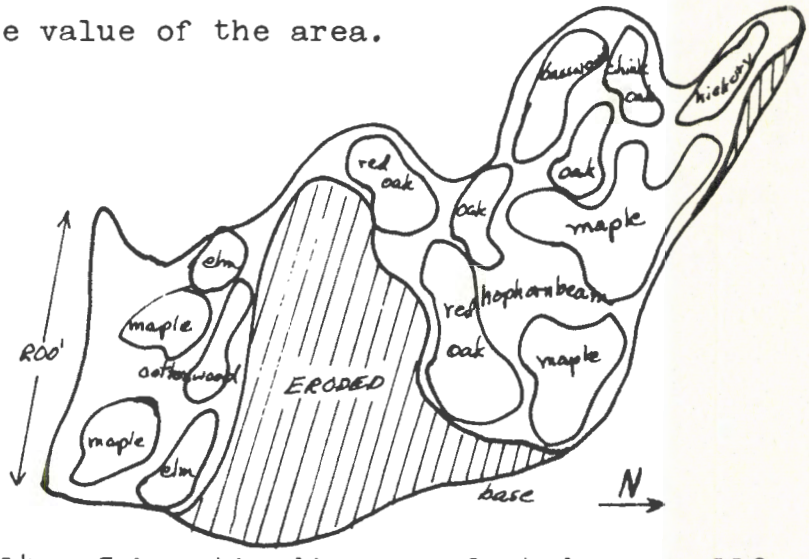



Fig. 114. Schematic diagram of study area 112

Study Area 113

The southerly exposed slope is cut by three smaller gorges which flow from the north. The area extends approximately 300 feet from the main gorge with a vertical drop of 200 feet at its deepest end. Its grade varies from 50 to 80

degrees being severest at its eastern end. The eastern end is also hampered by erosion which cuts a small ravine from its summit to the creek below.

The overstory is thick, covering 90 percent of the surface with a dense canopy of branches and foliage. Smaller gorges are more diversified in the species represented and stabilized by their presence. Oak (Quercus macrocarpa, Q. alba, Q. borealis) dominates the higher elevations with maple (Acer nigrum) dominating the lower extremities. Dominants are supported by basswood (Tilia americana), ash (Fraxinus pennsylvanica lanceolata), shagbark hickory (Carya ovata), elm (Ulmus americana) and boxelder (Acer negundo). Direct light reaching the floor is reduced to 10 percent by the canopy limiting plant growth at lower levels. The understory is dominated by maple (Acer nigrum) and includes a few elm (Ulmus americana) and basswood (Tilia americana). Groundcover is sparse, blanketed by a thick layer of litter produced by the overstory.

The vegetation on this study area is well developed and should be maintained for further study. Its slopes are best observed from the shoulder since the steepness limits its maneuverability.

Study Area 114

The area is adjacent to the major floodplain and is exposed to the east. Its length extends approximately 600 feet

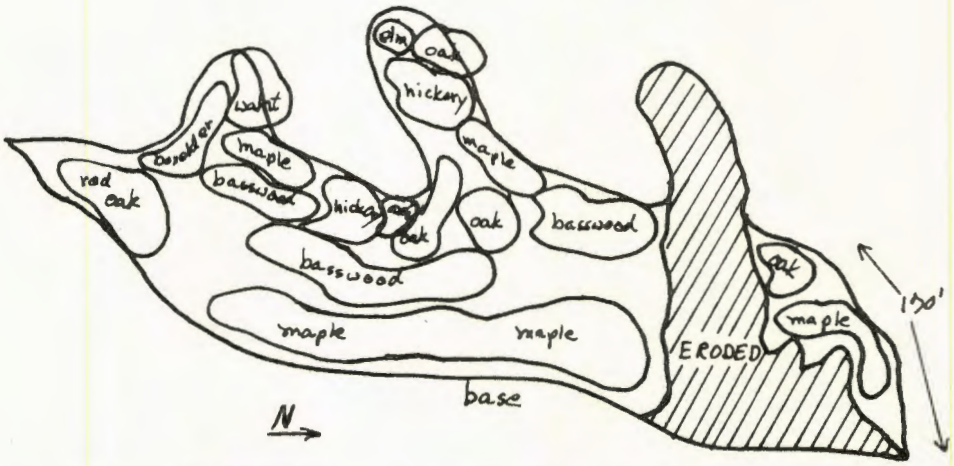



Fig. 115. Schematic diagram of study area 113

with a vertical drop of 200 feet. A grade averaging 70 degrees leaves the surface susceptible to erosion as waters increase velocity down the slope. Animal trails are common in all directions. The trails are not defined enough for use as footpaths , and, therefore, will not be considered. Disturbances in the area include erosion near the base and vegetation disturbances caused by the death of elm trees.

The overstory dominance is shared by oak and maple which grow on all levels of the slope. Red oak (Quercus borealis), bur oak (Q. macrocarpa), chinkapin oak (Q. muhlenbergi), black maple (Acer nigrum), basswood (Tilia americana), cottonwood (Populus deltoides), elm (Ulmus americana), shagbark hickory (Carya ovata), black walnut (Juglans nigra) and willow (Salix nigra) are included in this diverse overstory. The canopy produced by these species reduces light by 50 percent, leaving many sections open to the direct rays of the sun. In these areas, maple and hophornbeam (Ostrya virginiana) produce

a dense understory at a height of twenty feet. The undercover is well developed, except on eroded surfaces. Many species in the overstory are represented in the groundcover, indicating one step in a cycle of reproduction of the dominant strata.

Area 114 will be utilized best as an undisturbed slope, since the property boundary is only a few feet to the east. The overstory would be well used as a background for new plantings on the summit of Area 114.

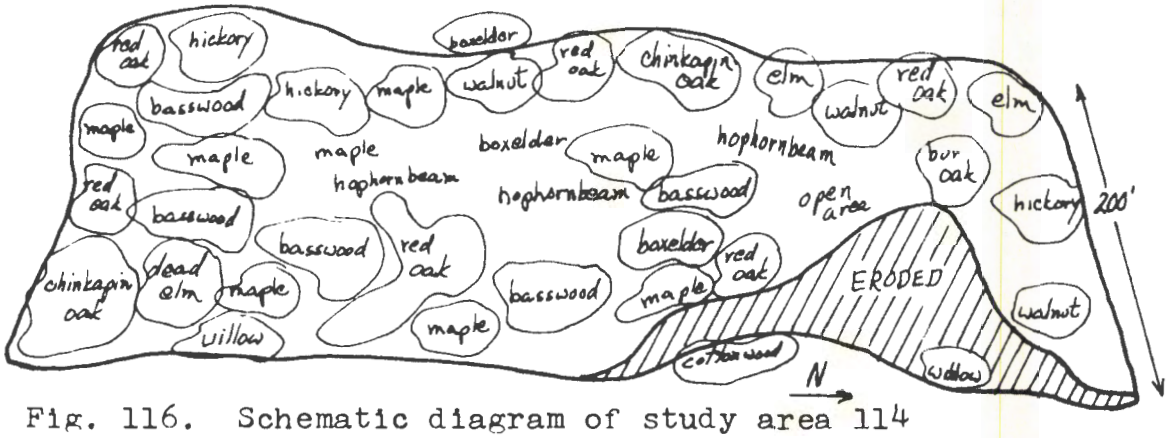



Fig. 116. Schematic diagram of study area 114

Study Area 115

Area 115 consists of a northerly exposed sideslope which extends into a secondary drainage gorge. The surface is disturbed by erosion which washes soil to the base allowing the stream to carry it away. Stretching 250 feet into the gorge, the slope has a vertical drop of 180 feet. The 80-degree slope makes walking difficult and in places impossible. Vegetation may be viewed from the summit, since the sparse understory presents no obstruction.

The overstory is dominated by maple (Acer nigrum), growing on lower levels of the slope. Basswood (Tilia americana), red oak (Quercus borealis), bur oak (Q. macrocarpa), hackberry (Celtis occidentalis), shagbark hickory (Carya ovata), black walnut (Juglans nigra), elm (Ulmus americana) and cottonwood (Populus deltoides) add equal amount of cover to the canopy. The understory is well developed over most areas dominated by hophornbeam (Ostrya virginiana) and supported by black maple, hickory and basswood. Understory species are concentrated on higher levels of the slope and under openings in the canopy. Groundcover follows the same pattern with a sparse representation. Litter production is heavy, leaving a carpet of leaves and small branches over the surface.

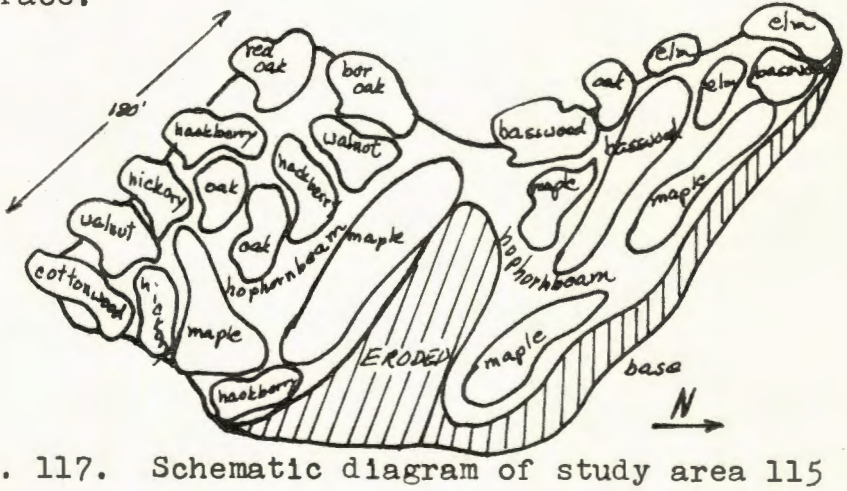



Fig. 117. Schematic diagram of study area 115

Study Area 116

Area 116 is a southerly exposed sideslope of a short, secondary gorge. Its length extends approximately 200 feet

with a vertical drop of 150 feet at its deepest end. The surface slopes 70 degrees over most portions with slight increases down on eroded base.

An overstory dominated by oak covers 90 percent of the surface with a dense canopy. Red oak (Quercus borealis) supported by black maple (Acer nigrum), basswood (Tilia americana) and hackberry produce the dense overstory which reduces light reaching the floor to 10 percent. Maple dominates the understory at all elevations with a few elm (Ulmus americana) and hophornbeam (Ostrya virginiana) sparsely scattered through this strata. Undercover is dense, covering all but the eroded surface at the base. The groundcover is mulched by a thick layer of leaves produced by the overstory.

Area 116 is an excellent example of a community undergoing change. The maple of the understory will one day dominate the slope, since the oak are unable to reproduce under the dense shade of the canopy.

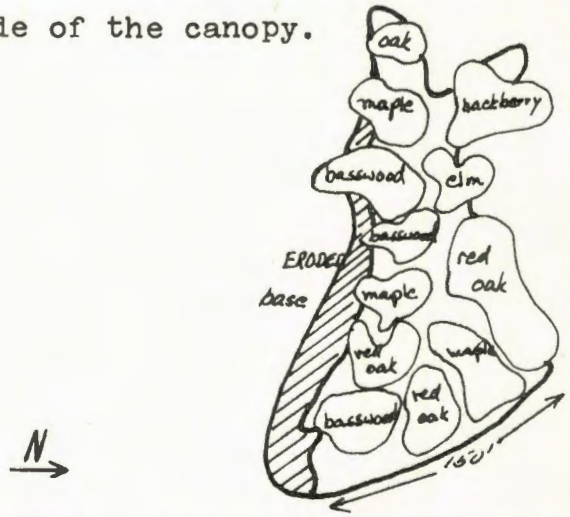



Fig. 118. Schematic diagram of study area 116

The section designated as Area 117 borders the creek which erodes its base and is exposed to the east. The sloping area is approximately 350 feet long with a vertical drop of 180 feet and a grade averaging 70 degrees being most extreme at the base.

Overstory species include white oak (Quercus alba), bur oak (Q. macrocarpa), red oak (Q. borealis) chinkapin oak (Q. muhlenbergi), black walnut (Juglans nigra). shagbark hickory (Carya ovata) and elm (Ulmus americana). Oak dominates the canopy which covers 90 percent of the surface, reducing light to 20 percent. The understory is entirely hophornbeam (Ostrya virginiana) growing at all levels of the slope. Undercover species carpet the surface, except for eroded areas at the base. Many oak seedlings are sprouting through this cover in hopes of reaching the overstory. These seedlings should maintain the oak dominance of the area.

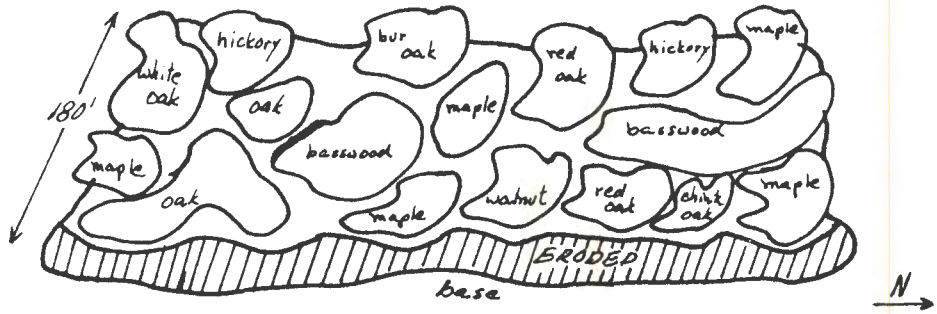



Fig. 119. Schematic diagram of study area 117

Study Area 118

Area 118 extends westerly into a secondary gorge. Its surface is exposed to the north and is divided by the northern property boundary. Two gorges cut into the surface. One has been stabilized by vegetation, and the other is young and still actively eroding. The surface is steep with a 70-degree slope ending at the creek below. Its length is approximately 300 feet, and its deepest vertical drop extends 160 feet. There are no defined trails on the slope, making it extremely difficult to walk. It is best viewed from the summit overlooking the area.

An overstory dominated by oak forms a dense canopy over the surface, reducing light to 10 percent. White oak (Quercus alba), red oak (Q. borealis) and bur oak (Q. macrocarpa) are the dominant species with black maple (Acer nigrum), basswood (Tilia americana), black walnut (Juglans nigra), hickory (Carya glabra) and elm (Ulmus americana) contributing to the diversity of the community. Maple dominates the understory which includes hophornbeam (Ostrya virginiana) and hickory. The density of the maple and its ability to survive under the shaded conditions indicate some changes in dominance if overstory species should die. The undercover is sparse due to the dense shade and disturbance from excess run-off water. Litter production is high, but accumulation on the surface is hampered by the steepness of the slope. Litter is washed to

the base where it forms deep pockets of organic material.

Vegetation on this study site represents many species and a changing dominance in the overstory. These characteristics are worthy of preservation and recommendations should include this area as a natural study area. Stabilization of eroded sections is of importance, since this disturbance disrupts vegetation at all levels.

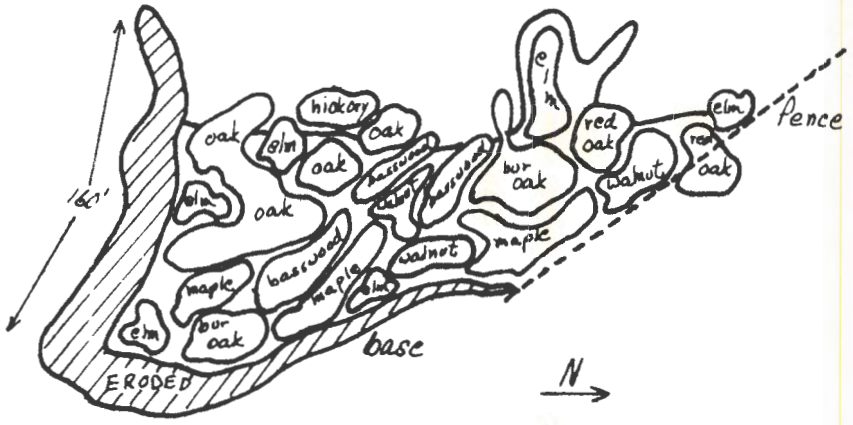



Fig. 120. Schematic diagram of study area 118

Study Area 119

Area 119 represents the lowest elevation in the study region. It is composed of bottomland and includes a floodplain and a small amount of terrace at two levels. The terrace is usually adjacent to slopes and, in some cases, is part of the toeslope or footslope.

Richardson's Branch is the major stream flowing through Area 119. It is joined by a smaller tributary flowing from the northeast. Richardson's Branch services a large watershed, and the amount of flow varies with precipitation over

the area. During summer months many springs flow into the stream from bordering slopes. These springs present erosion problems on steep surfaces, causing soil to slide into the stream. The stream is unstable through much of the floodplain, shifting its borders in response to seasonal variations in depth. Its banks become more stable to the south where the channel cuts through a terrace of alluvial deposits, digging a deep bed with high walls. The stream flows over large rocks which in places form rapids with water gushing over and between their surfaces. Other sections of the stream are dammed by fallen trees uprooted by the velocity of the water.

Low areas form bogs at a number of locations through the floodplain, creating deposits of organic material, as they dry during summer months. Few woody species are found on these areas, since unstable condition will not support heavy forms of plant material. Decaying tree trunks, which once grew near these areas are found half submerged as wind pushes the poorly-rooted trees to the ground.

Willow (Salix interior), honey locust (Gleditsia triacanthos), cottonwood (Populus deltoides) and red mulberry (Morus rubra) predominate the overstory species of this area. Their numbers are few and arrangement random over the shifting surface. A number of basswood (Tilia americana), black maplr (Acer nigrum) and bur oak (Quercus macrocarpa) populate the terrace areas with a greater density.

The most distinguishing feature of the herbaceous materials that cover the floor is the dense population of horsetails (Equisetum sp.) growing in thick communities bordering the stream. Their stems produce a rigid texture against the water flowing through the stream. The willow grows in similar communities on each side of the stream producing a corridor effect.

A great amount of erosion exists through Area 119 as the stream erodes sideslopes. The material is deposited at lower levels of the floodplain and in the stream bottom. The unstable positions of the stream bed limits areas to be used as footpaths or roads. Terrace areas are more stable than the lower floodplain making them prime locations for roads and walkways. The alluvial deposits which formed these terraces should present adequate foundations for the surface to be traveled.

Sections specified as Area 119 can be found on Fig. 121 showing the location of the present stream bed and boundaries of the area.

Study Area 120

Area 120 represents the largest portion of land located on the summits, overlooking the slopes and bottomland. This area of the summit is presently used as farmland for corn and soybeans. The area is free of overstory vegetation as well as understory or undercover. Its surface is plowed each

spring, encouraging run-off water to carry soil with it on journeys down neighboring slopes. This practice must be stopped in an effort to stabilize the summits as well as sideslopes affected by the runoff.

Area 120 will be an important area to the arboretum, since its surface contains highly developed top soil on a flat topography with no erosion except that caused by cultivation. Sections within this area present opportunities for a number of uses. Field succession studies might be conducted as cultivation is discontinued as well as studies to determine the most efficient means of stabilization. Sections could also be used as test sites for woody species and display areas for the various members of the Iowa Horticultural Society. Parking facilities, roadways and buildings could be located on this area with buildings concentrated on the forty acres owned by Iowa Arboretum, Incorporated. Area 120 will be most popular, since it is easily traveled and offers views of vegetation on the slopes.

Study Area 121

A small section of the summit area is being used by the United States Forestry Service as a test site for walnut trees. The site is represented by Area 121 which is isolated and bordered on three sides by slopes. The seedlings involved in the experiment are two years old and planted in rows across the two-acre site. Future plans for the test are not known

at present but the trees would be of great value to the arboretum, if they are left to cover the area. The location of this area can be found on Fig. 121, which shows its dimensions and relation to other areas.

Study Area 122

Sections grouped under the designation of Area 122 represent old field succession. The age of trees growing here indicates that cultivation was discontinued over ten years ago. Woody vegetation consists of a dense grove of honey locust (Gleditsia triacanthos) with thorny branches hanging two feet over the surface. It is difficult to travel through these areas, since the low canopy partitions the surface with its dangerous branches.

Area 122 is an interesting study of old field succession and could be maintained for this purpose. If it is to be used for other purposes, the honey locust must be removed or pruned higher to allow movement under the canopy.

Study Area 123

This small area supports a dense canopy of shagbark hickory (Carya ovata) which covers the entire surface. Trees are randomly spaced and occur in a variety of sizes, indicating that they were not cultivated as the first impression suggests. Hickories are usually found in association with oaks and not in uniform communities which is the case here. They

are dry association plants and since Area 123 is a slender summit between two gorges, it is not unnatural for them to grow as they do.

This area should be maintained, since it is for the study of seedling variation within a species. It is interesting to witness the differences in bark textures which have resulted from genetic differences in the seed source. These differences are also evident in leaf shapes and nut variations.

Study Area 124

Area 124 is a transition zone between the wooded slopes and cultivated fields. The surface of this area is generally the shoulder of a slope or the summit just above it. Major disturbances of this area have been the use of this land for grazing and the removal of overstory trees for lumber and fuel. This area will be of great importance to the arboretum, since the overstory of the slopes offers a background for planting of interest to the public. The surface is level and presents no problem to the movement of systems through the area.

Overstory species are concentrated along fence lines and are extensions of the adjacent slope canopies. Species included are red oak (Quercus borealis), white oak (Q. alba), bur oak (Q. macrocarpa), chinkapin oak (Q. muhlenbergi),

black maple (Acer nigrum), basswood (Tilia americana), shagbark hickory (Carya ovata), honey locust (Gleditsia triacanthos), quaking aspen (Populus tremuloides), ash (Fraxinus pennsylvanica lanceolata) and elm (Ulmus americana).

A dangerous situation has developed as the elm die, leaving weak branches hanging from the dried trunks. These branches fall across possible movement areas making them unsafe. If the trees are not removed, movement systems will be routed away from areas containing elm.

This area is likely to be the first to be developed, since many of the slopes and portions of the floodplain can be viewed from the overlooks which naturally occur through this section. Development in the early stages would only require the removal of fences which surround the area and mowing of the brush to ensure safe walking.

Study Area 125

Sections designated as Area 125 will not be included in this study, since their locations are isolated and of little value to the arboretum, except as a buffer zone between it and neighboring farm operations. Use of these areas would be difficult, since the access routes to them are not included in property owned or leased by the arboretum.

# ANALYSIS

## Vegetation

Description of 124 study areas are compiled on a map (Fig. 121) giving the location of each area and the dominant overstory association represented. Sloping areas were dominated by 13 overstory association types. These were variations of the oak-hickory (*Quercus* spp. and *Carya* spp.) and maple-basswood (*Acer nigrum* and *Tilia americana*) and, in cases, combinations of the two. Bottomland is dominated by an association of cottonwood (*Populus deltoides*) and willow (*Salix nigra*). This association corresponds to forest cover type 63 listed in *Forest Cover Types of North America* (27) and was the only association observed in the publication. Summit positions have been disturbed and are represented by three associations greatly modified by grazing and cultivation.

The major factor influencing the overstory vegetation on slopes is the direction to which the slope is exposed. Exposure affects temperature and moisture factors which determine the capability of species to survive. For this reason, the overstory vegetation survey has been analyzed in five parts. Northern, eastern, western and southern slope exposures are grouped on separate tables to determine dominant vegetation with respect to exposure.

## LEGEND

1–125 study areas

| | |
|---|---|
| M | maple |
| O | oak |
| H | hickory |
| w | willow |
| C | cottonwood |
| E | elm |
| Ho | honeylocust |
| Cu | cultivated |
| Er | eroded |
| NS | not surveyed |

Letter combinations constitute overstory associations

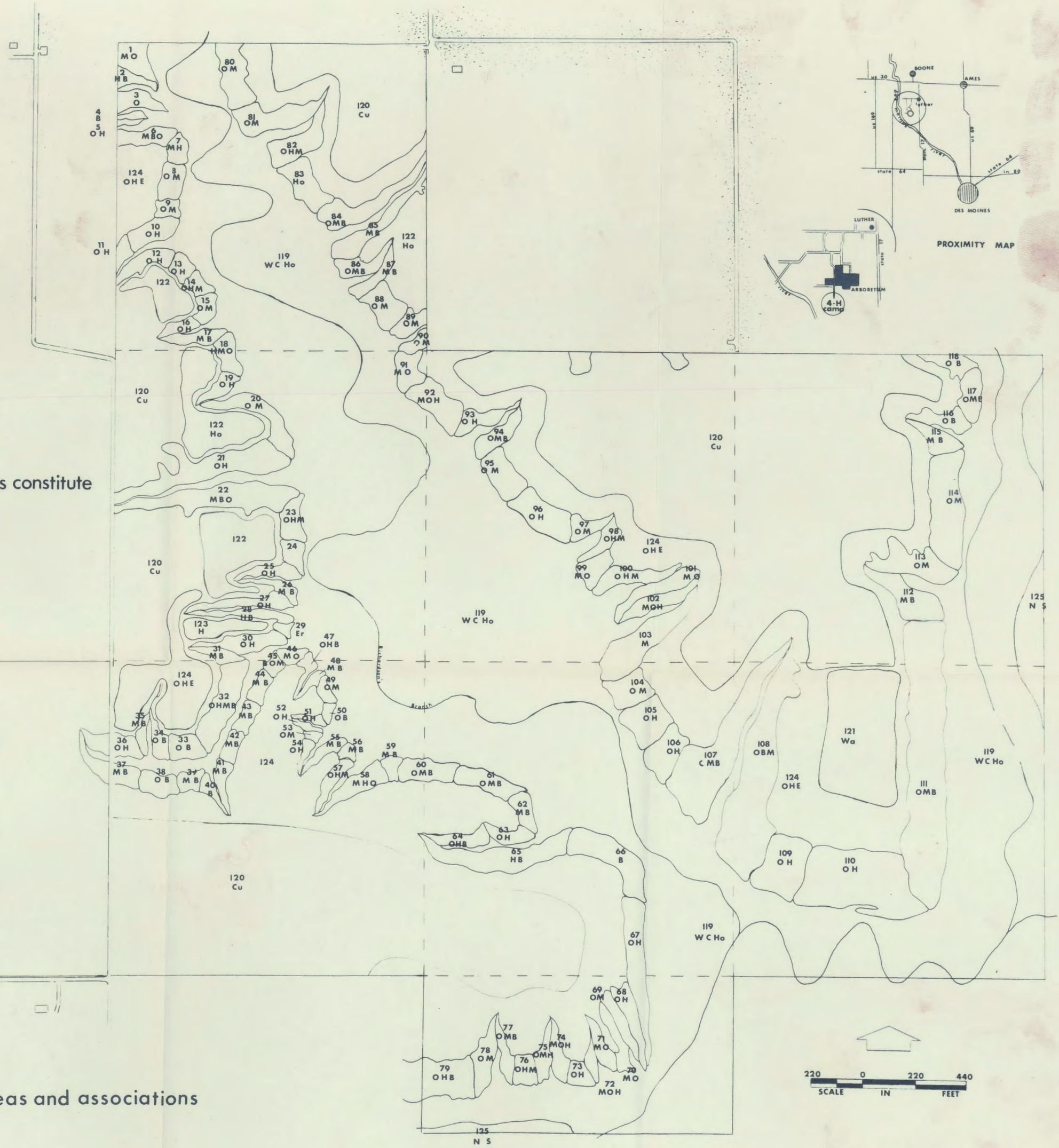



FIG. 121 study areas and associations

Table 1. Overstory associations located on north-exposed slopes and approximate acreage of each study area

| Study area | Approximate acreage | Total acreage |
|---|---|---|
| Maple-basswood association | | |
| 17 | .6 | |
| 26 | .3 | |
| 31 | .3 | |
| 37 | .5 | |
| 39 | .4 | |
| 48 | .2 | |
| 55 | .4 | |
| 59 | .3 | |
| 85 | 1.6 | |
| 87 | 1.0 | |
| 112 | 2.3 | |
| 115 | 1.2 | |
| | | 9.1 |
| Maple-basswood-oak association | | |
| 6 | .6 | |
| 22 | 2.0 | |
| 60 | 1.0 | |
| 61 | 1.2 | |
| 94 | .7 | |
| | | 5.5 |
| Maple-oak association | | |
| 46 | .2 | |
| 90 | .4 | |
| 101 | 1.0 | |
| | | 1.6 |
| Maple-oak-hickory association | | |
| 14 | .3 | |
| 92 | 1.3 | |
| 98 | 1.0 | |
| | | 2.6 |

Table 1 (Continued)

| Study area | Approximate acreage | Total acreage |
|---|---|---|
| Basswood-hickory association | | |
| 28 | 1.0 | |
| 65 | 2.0 | |
| | | 3.0 |
| Basswood-oak association | | |
| 38 | .6 | |
| 118 | .9 | |
| | | 1.5 |
| Basswood association | | |
| 4 | .1 | |
| | | .1 |
| Maple association | | |
| 103 | 2.6 | 2.6 |
| Oak-hickory association | | |
| 12 | .6 | |
| 52 | .3 | .9 |
| Grand total | | 26.9 |

Northern slope exposures are tabulated in Table 1 represented by nine associations. These 31 study areas are dominated by maple-basswood associations. Northern exposures are relatively moist and cool since little direct solar radiation reaches the surface. These conditions favor the maple and basswood. Variations of overstory vegetation with regard to exposure are evident in Table 1. These situations are created by a number of factors. All of these areas do not face directly north, and variations in direction offset the microclimate of the surface. Northwestern exposures, for example, would be warmer and drier, influencing the vegetation on such a surface. Drainage and elevation also influence the overstory vegetation. It is not uncommon to find northern slope exposures with two distinct overstory communities. Areas were observed which supported oak and hickory at higher elevations with maple at basswood at lower levels. This represents the influence of moisture where shoulder slopes are well drained and footslopes moderately drained. Slopes which are exposed to floodplains rather than confined ravines tend to develop thick colluvial deposits on footslopes creating a deep, well-drained soil. This influences vegetation as in study area 61 where the footslope has developed into a terrace from colluvial deposits.

East exposures are compiled in Table 2 listing the overstory associations represented and approximate acreage

involved. The canopy dominance is shared by maple, basswood and oak. This exposure is less moist than the north exposure, and the vegetation is a mixture of the maple-basswood and oak hickory associations. Nine variations of these associations are indicated by the 31 study areas listed.

Table 2. Overstory associations located on east-exposed slopes and approximate acreage of each study area

| Study area | Approximate acreage | Total acreage |
|---|---|---|
| Oak-maple association | | |
| 1 | .6 | |
| 8 | .6 | |
| 9 | .3 | |
| 15 | .3 | |
| 20 | 1.2 | |
| 49 | .3 | |
| 70 | .9 | |
| 78 | 1.2 | |
| 97 | .6 | |
| 114 | 2.0 | |
| | | 8.0 |
| Oak-maple-basswood association | | |
| 58 | .3 | |
| 84 | 1.6 | |
| 107 | 3.5 | |
| 111 | 4.7 | |
| 117 | 1.1 | |
| | | 11.2 |
| Oak-maple-hickory association | | |
| 18 | .6 | |
| 32 | 1.0 | |
| 57 | 1.0 | |
| 72 | .4 | |
| 75 | .4 | |
| | | 3.4 |

Table 2 (Continued)

| Study area | Approximate acreage | Total acreage |
|---|---|---|
| Oak-hickory association | | |
| 11 | .3 | |
| 13 | .3 | |
| 54 | .4 | |
| 67 | .9 | |
| | | 1.9 |
| Maple-basswood association | | |
| 35 | .5 | |
| 56 | .6 | |
| 62 | .6 | |
| | | 1.7 |
| Oak association | | |
| 3 | .5 | |
| | | .5 |
| Basswood association | | |
| 40 | .4 | |
| 66 | 2.1 | |
| | | 2.5 |
| Maple-hickory association | | |
| 7 | .3 | |
| | | .3 |
| Oak-basswood association | | |
| 50 | .3 | |
| | | .3 |
| | Grand total | 29.8 |

Table 3 includes slopes which are exposed to the west. Although these areas are warmer and drier than the north and east exposures, they support much of the same vegetation. five associations are listed with dominance controlled by maple and oak. Vegetation in these areas has suffered from lumber operations. Many oaks have been removed by logging operations, influencing the observations listed in Table 3. Seventeen study areas are included covering approximately 15 acres.

Table 3. Overstory associations located on west-exposed slopes and approximate acreage of each study area

| Study area | Approximate acreage | Total acreage |
|---|---|---|
| Maple-oak association | | |
| 69 | .8 | |
| 71 | .9 | |
| 80 | 1.0 | |
| 88 | 1.0 | |
| 95 | 1.0 | |
| | | 4.7 |
| Maple-basswood association | | |
| 41 | .4 | |
| 42 | .3 | |
| 43 | .3 | |
| 44 | .3 | |
| | | 1.3 |

Table 3 (Continued)

| Study area | Approximate acreage | Total acreage |
|---|---|---|
| Maple-basswood-oak association | | |
| 45 | .2 | |
| 77 | .9 | |
| 91 | 1.0 | |
| 108 | 4.0 | |
| | | 6.1 |
| Maple-oak-hickory association | | |
| 58 | 1.0 | |
| 74 | .4 | |
| 92 | 1.2 | |
| | | 2.6 |
| Oak-basswood association | | |
| 34 | .5 | |
| | | .5 |
| Grand total | | 15.2 |

Slopes with southern exposures are dominated by oak and hickory. This exposure receives the greatest amount of direct radiation making it the warmest exposure and, consequently, the driest. Six associations are listed on Table 4, most of which are variations of the oak-hickory association type. A majority of the southerly exposed slopes are found in regions of minimal disturbances and where lumber operations and

grazing did not influence the vegetation. Those found in the southern part of the arboretum are undisturbed and represent natural conditions. Maple and basswood are found on foot-slopes of southerly exposed areas where adequate moisture is available. There are 35 study areas listed on Table 4 covering approximately 30 acres.

Table 4. Overstory associations located on south-exposed slopes and approximate acreage of each study area

| Study area | Approximate Acreage | Total Acreage |
|---|---|---|
| Oak-hickory association | | |
| 5 | .1 | |
| 10 | .6 | |
| 16 | .3 | |
| 19 | .6 | |
| 21 | 2.0 | |
| 25 | .3 | |
| 27 | 1.0 | |
| 30 | 1.0 | |
| 36 | .5 | |
| 51 | .3 | |
| 63 | .6 | |
| 68 | .9 | |
| 73 | .4 | |
| 93 | .7 | |
| 96 | 1.2 | |
| 105 | 1.2 | |
| 106 | 1.0 | |
| 109 | 1.2 | |
| 110 | 2.2 | |
| | | 16.1 |

Table 4 (Continued)

| Study area | Approximate acreage | Total acreage |
|---|---|---|
| Oak-hickory-maple association | | |
| 24 | .4 | |
| 76 | .4 | |
| 100 | .7 | |
| 102 | 1.0 | |
| | | 2.5 |
| Oak-hickory-basswood association | | |
| 47 | .3 | |
| 64 | .6 | |
| 79 | 1.2 | |
| | | 2.1 |
| Oak-maple association | | |
| 81 | 1.3 | |
| 86 | 1.1 | |
| 89 | .6 | |
| 104 | 1.0 | |
| 113 | 2.4 | |
| | | 6.4 |
| Oak--basswood association | | |
| 23 | .6 | |
| 33 | 1.0 | |
| 116 | 1.3 | |
| | | 2.9 |
| Hickory-basswood association | | |
| 2 | .3 | |
| | | .3 |
| Grand total | | 30.3 |

Table 5 lists vegetation found on summit areas. The overstory found over bottomland is dominated by willow and cottonwood. This community represents a wet association, since the area is located in the floodplain of Richardson's Branch.

The largest quantity of land found on summit positions is under cultivation. Portions of this land are considered old field successions, since they have not been plowed since 1950 and support a dense growth of honey locust. Study Area 121 is a **black** walnut planting designed as a test by the United States Forestry Department. Trees are two years old and poorly maintained. Areas located adjacent to the slope are considered as the ecotone regions. This area is dominated by oak and hickory with intrusions by elm along old fence rows. Most areas in this category have been grazed leaving little understory or undercover. One peculiar area is covered entirely by shagbark hickory (Carya ovata) and is described as Area 123.

These results indicate agreement in slope composition using this technique and those of Sanders (55) in studying forestry patterns by the use of Daubenmere's cover classes (18) and a continuum index devised by Curtis and McIntosh (17). Acer nigrum has been given the highest continuum index for the region studied and is verified by the large number of maple seedlings observed in the understory and undercover.

Table 5. Overstory associations located on summit and bottomland areas and approximate acreage of each study area

| Study area | Association | Approximate area |
|---|---|---|
| 119 | Willow-cottonwood | 84.4 |
| 120 | Cultivated | 89.7 |
| 121 | Walnut (Experimental plot) | 3.0 |
| 122 | Honey locust | 6.3 |
| 123 | Shagbark hickory | .7 |
| 124 | Oak-hickory-elm (Ecotone) | 39.1 |

They were found on all areas except the floodplain and shoulder slopes of southerly exposed areas.

## Disturbances

The major source of disturbance is water erosion. Since cultivation began on summit areas, the amount of water flowing over slopes and through ravines has increased. Excess water has cut deeper channels through ravines leaving unsupported sideslopes to be washed away. Large quantities of water flow over shoulder slopes with velocities that wash litter and undercover vegetation to the base of the slopes,

leaving the surface unprotected. Fig. 122 locates these eroded areas which are usually found along foot- and toeslope regions. There are few conservation measures taken by the 4-H authorities or surrounding property owners. Until soil conservation is practiced on the cultivated areas, erosion is likely to continue its destruction.

A second disturbance indicated by Fig. 122 is the destruction of vegetation by lumber operations and trees felled by wind. The removal of timber from sloping areas has disturbed both under- and overstory vegetation. The understory is crushed by fallen trees, and the overstory is destroyed.

Dead elm are also located on Fig. 122. These trees are usually found on footslopes where moisture is adequate for their survival. A large number of dead elm are located along fencerows constructed by settlers on summit portions. Many of these trees require removal for safety and appearance.

Another disturbance considered is refuse dumps used by surrounding farmers and the 4-H Center. Ravines near roads are used to dump scrap lumber and dead trees. These dumps have smothered all vegetation and create an unsightly condition.

## Landmarks

Fig. 123 locates physical characteristics which have altered topography or vegetation. Animals have made trails

## LEGEND

road
animal trails
fences



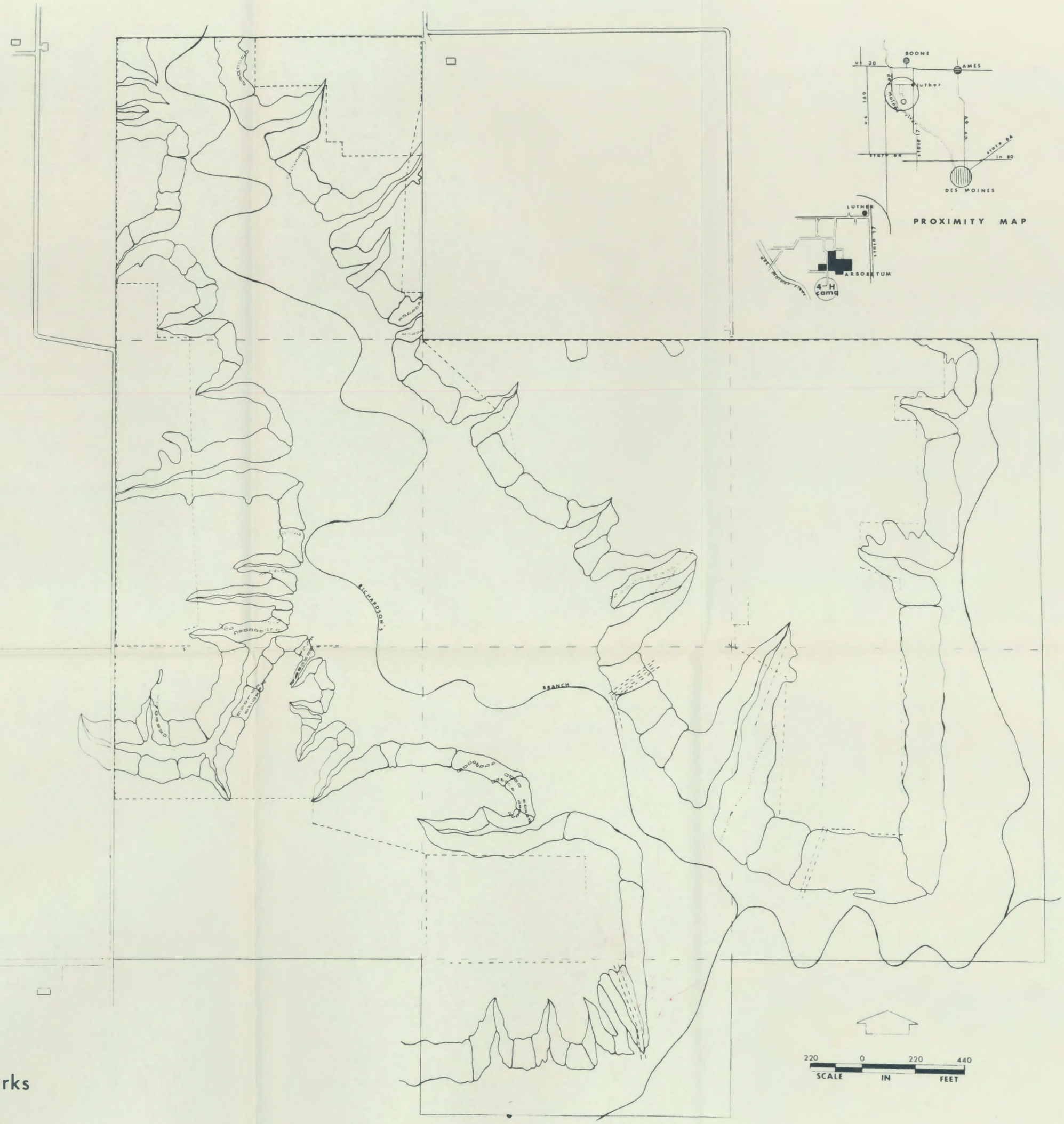




FIG. 123 landmarks

## LEGEND

- erosion
- dead elms
- cut or fallen trees
- × refuse




PROXIMITY MAP

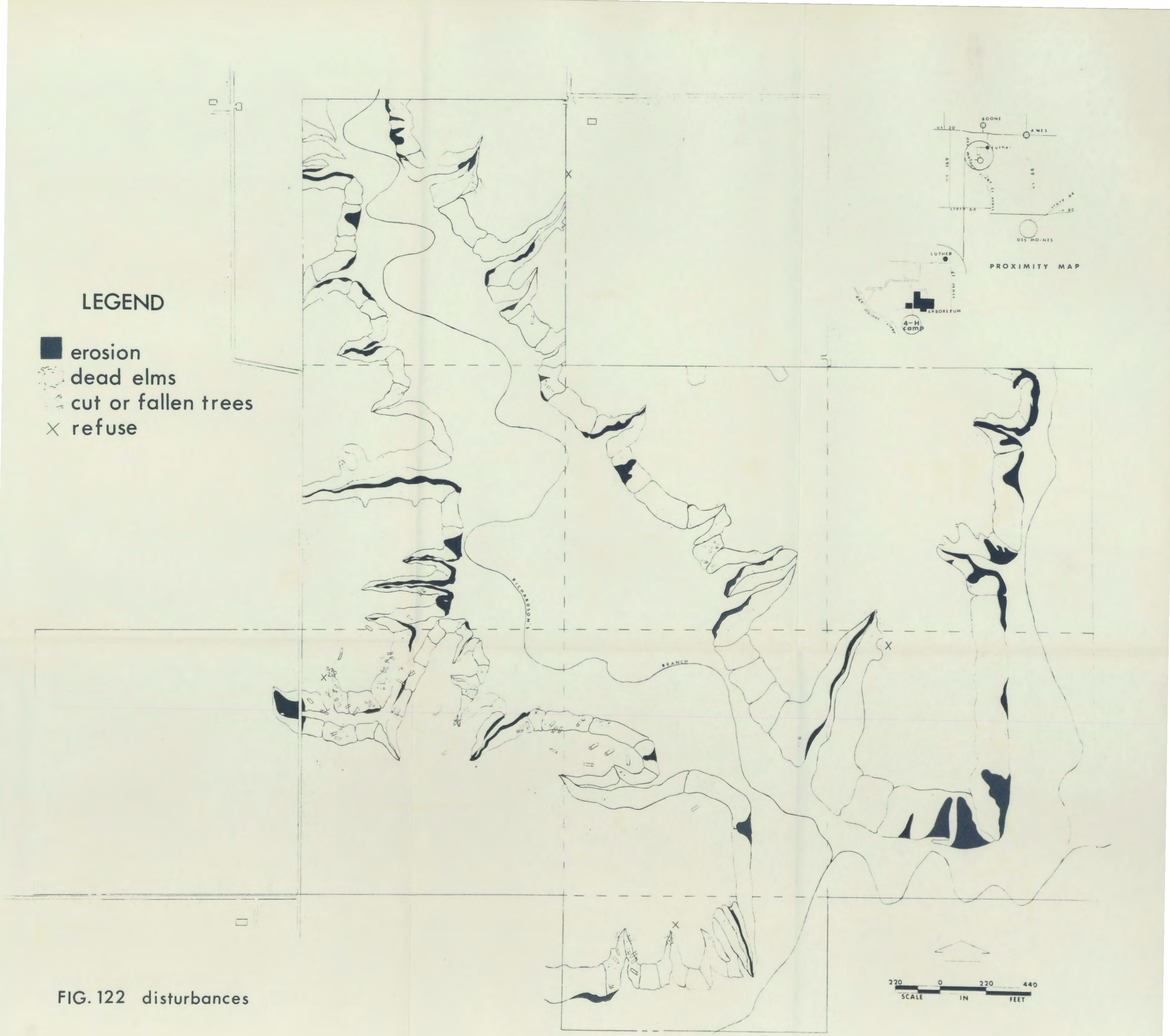


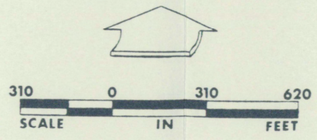

FIG. 122 disturbances

over many areas, some of which are adequate for foot trails. These have been observed and recorded on Fig. 123. Influences by man have been considered. The roads once used to carry coal and lumber up slopes are still evident and in some cases usable. Those in usable condition have been recorded in Fig. 123.

Fences have also been located since the strands of wire used in construction present problems to visitors.

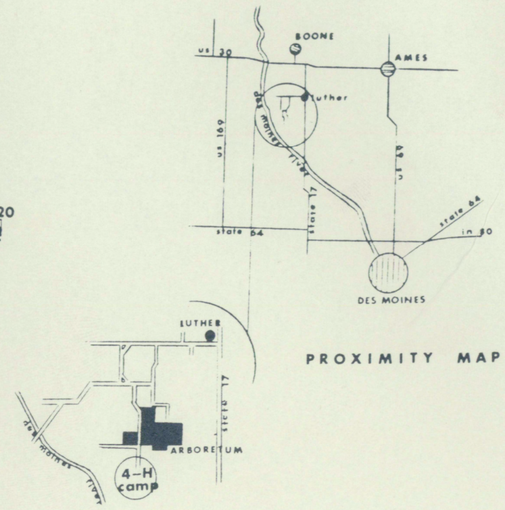
## Soil

Fig. 124 locates the soil types within the Arboretum. The material was compiled by Brown in 1936 and he lists three soil types (14). Conover silt loam covers summit positions with a steep phase Clarion loam on slopes. The alluvial soil in the floodplain is considered a sarpy silt loam. Clarion and Conover soils are formed in Wisconsin glacial till as indicated by the stratigraphic cross section on Fig. 124. Sarpy is formed in alluvial deposits. Development of these soils was influenced by parent material, topography, erosion, climate and vegetation. The properties of these soils should be considered in locating various planting and service facilities within the Arboretum.




## LEGEND

- conover silt loam
- clarion loam
- sarpy loam




PROXIMITY MAP

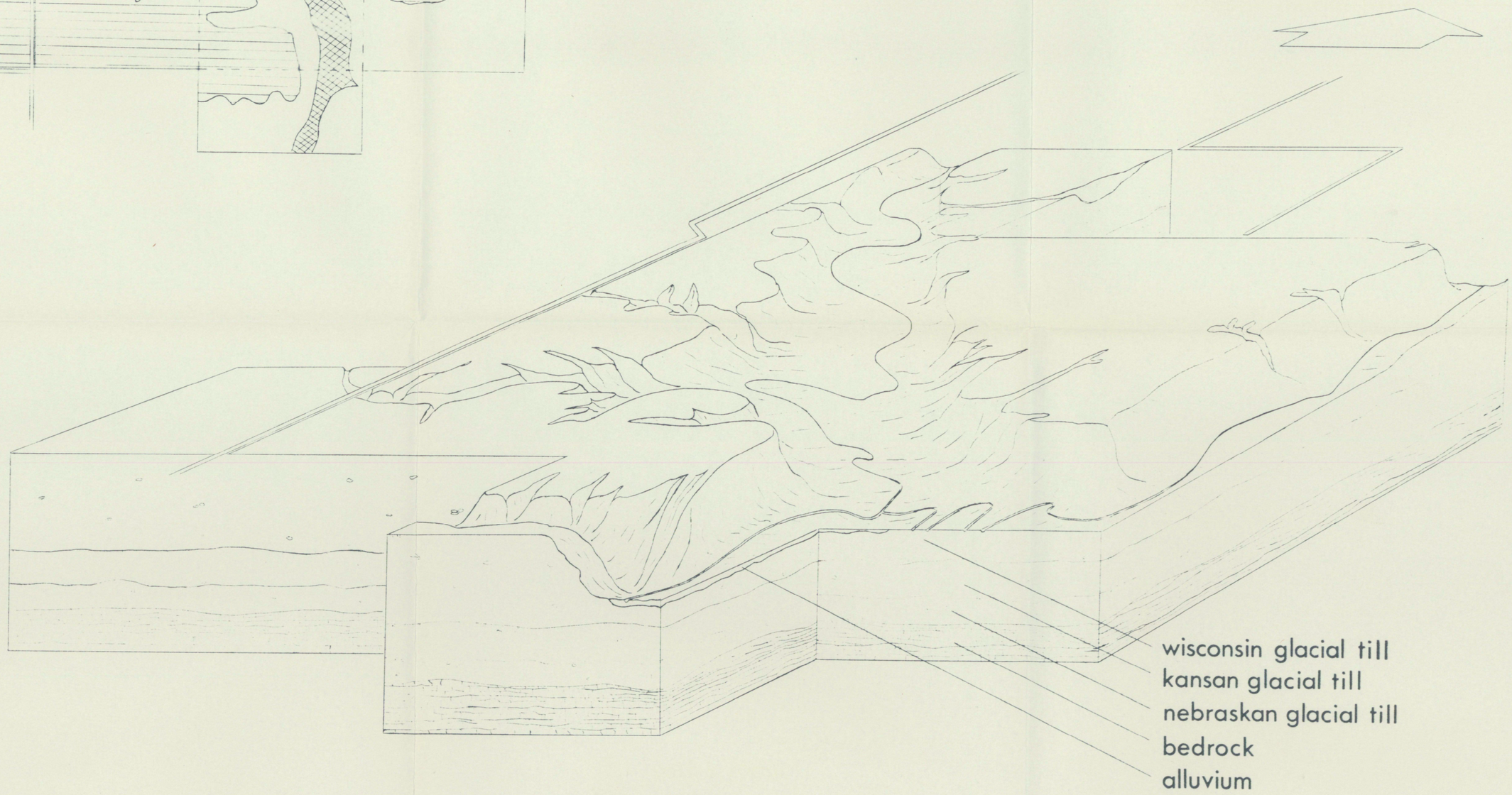



FIG. 124 soil and topography (14)

# RECOMMENDATIONS

## Purpose of An Arboretum

On January 19 and 20, 1926, hearings were held before the Committee on Agriculture, in the House of Representatives, and the Committee of Agriculture and Forestry of the United States Senate to continue discussion of a bill authorizing the Secretary of Agriculture to establish a national arboretum. The bill authorized establishment and maintenance of an arboretum for purposes of research and education concerning tree and plant life (47). During the first hearing in 1925, Coville (48) outlined fourteen statements concerning the purpose of a national arboretum.

Ten of these statements are applicable to the Iowa Arboretum and are listed below:

1. The arboretum will contain a comprehensive collection of trees and other outdoor plants for purposes of scientific research and education.

2. It will serve as an introduction garden for the permanent preservation of authentic living specimens of the thousands of plants introduced by the Department of Agriculture from foreign countries.

3. It will contain all the wild relatives of cultivated plants which will grow out of doors in this climate, and

will be an invaluable source of material for the breeding of more valuable varieties.

4. It will furnish such a knowledge of the breeding of forest trees as will make it possible, when the country reaches the point of setting out its forests, to use improved varieties which may grow twice as fast as those we now use.

5. It will furnish material for the breeding of disease-resistant varieties to replace many of the present cultivated varieties which are of high quality but so subject to disease that the cost of their treatment is a heavy burden on American agriculture.

6. As a living collection of the species and varieties of trees and other cultivated plants it will constitute a series of standards by which to establish the identity of the plants in the American horticultural trade.

7. The plants in an agricultural experiment station may be likened to the books which one keeps in his office for continual every-day use, while a national arboretum may be regarded as a great library of living trees and plants from which one can obtain at once whatever he needs for some special investigation or experiment.

8. The national arboretum at Washington will constitute an outdoor recreation area of 500 to 800 acres which will also be an instrument of widespread public education in botanical science, horticulture, agriculture, **and landscape gardening.**

9. The arboretum would constitute a permanent bird sanctuary.

10. The marsh area of the arboretum is well adapted to the development of a water garden the beauty of which is well illustrated by the Shaw waterlily gardens now occupying a portion of the marshes.

These statements outline the service offered by an arboretum and must be considered in recommending development procedures for such a facility.

## Initial Development

Recommendations are made in two categories. The first recommendation considers initial development and utilizes services of minimum expense. It is necessary that all buildings be constructed on the forty acres owned by the Iowa Arboretum, Incorporated. This would include the administrative buildings and maintenance facilities to service the entire area.

As indicated on Fig. 122 and Fig. 123, a number of disturbances are in need of correction before development can proceed. Erosion is the greatest disturbance and the most costly expense. Soil conservation measures must be taken at the earliest possible date to prevent the devastation of slopes and vegetation. Cultivation on summits adjacent to Richardson's Branch should be discontinued, and appropriate

measures taken to stabilize the soil. Cooperation from neighboring farms would be necessary to insure adequate conservation through the entire watershed.

Dead trees require removal to insure the safety of visitors from the dangers of falling limbs. Some areas require the removal of fallen trees which block access routes through the Arboretum. Other problems mentioned earlier, such as refuse piles and old fences are also recommended for removal. Utilizing the schematic diagrams will aid in locating these disturbances.

Fig. 125 represents recommendations for initial stages of development. It includes trails of various lengths and degrees of difficulty with signs of direction and interpretation. Trails meander through a representative sample of overstory associations found in the Arboretum. Shelters will provide rest stops and meeting places for organizations wishing to gather out-of-doors. A short road will provide access to different sections of the Arboretum with parking facilities at designated points.

Since the Arboretum will be sponsored by donations, it would be wise to consider a systematic approach to its development beginning with nature trails and overlooks which already exist and slowly expanding to the development of display gardens and test plots.

## LEGEND

- ///// parking
- road
- foot trail
- overlook
- sign – direction
- ▲ sign – interpretive
- shelter

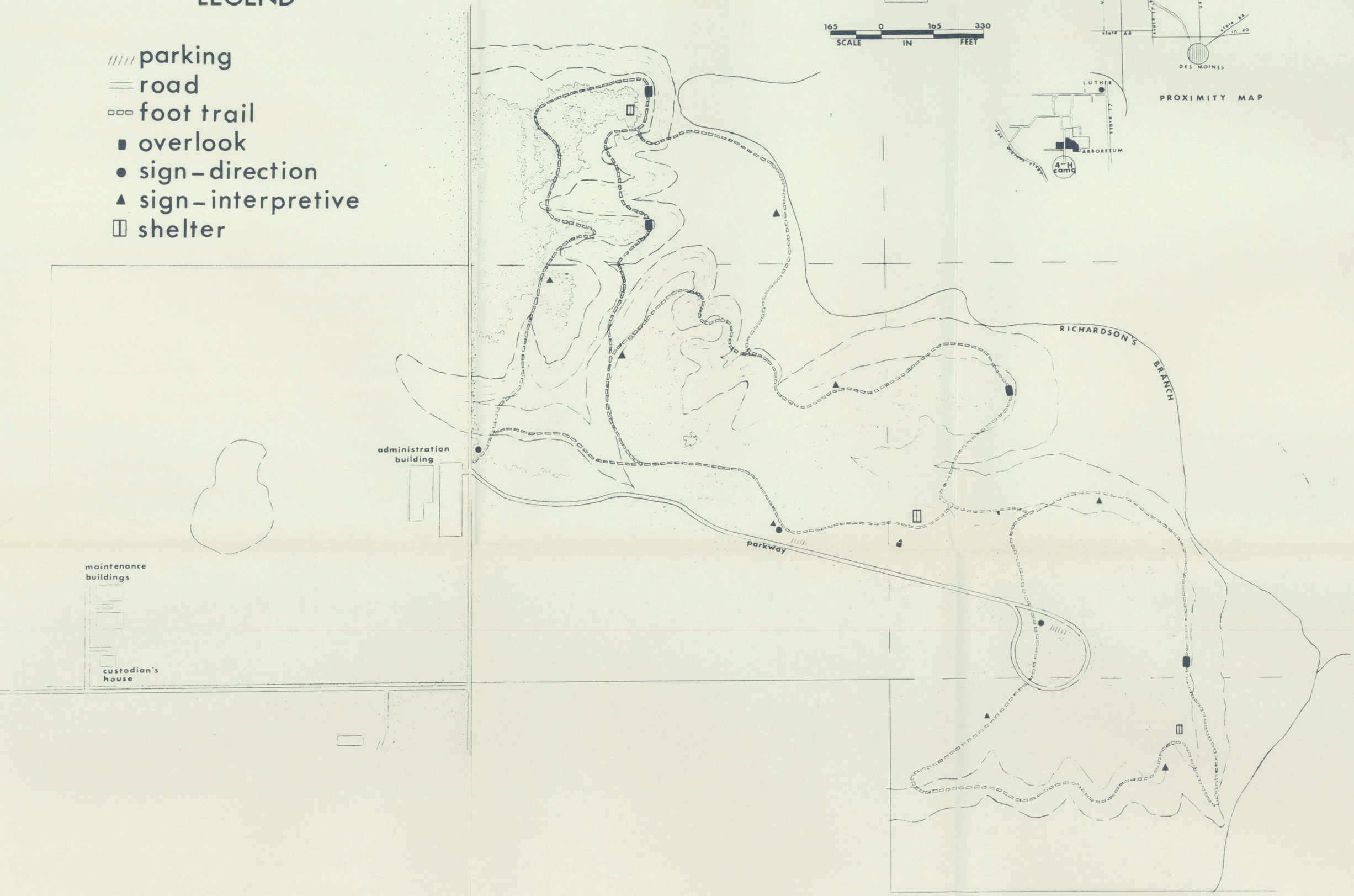



FIG. 125 initial development

## Long-Term Development

Fig. 126 foresees future development with acquisition of surrounding land and includes recommendations for long-term development. Realizing the possibility of commercial operations or unsightly structures locating on land adjacent to the Arboretum, it is recommended that additional land be acquired on the west, north and east sides of the Arboretum. The east boundary could be preserved in natural vegetation to provide an excellent screen from neighboring land. The boundary, if extended to the township, would border the road and could be used as a main entrance to the eastern side of Richardson's Branch. Land adjacent to the forty acres owned by the Arboretum could be used to construct a nine-hole golf course, providing a source of income, buffer zone to the west, and an excellent method of displaying shade trees.

The prairie would be located on the summit east of Richardson's Branch and a parkway constructed through it and other communities east of the Branch. Fig. 126 locates a road connecting the east and west sides of Richardson's Branch. The recommendation is optional since the roadbed to the summit would require the destruction of study area 22. Extension of trail systems are indicated with overlook signs and shelters.

Test gardens are recommended on the Arboretum's eastern boundary away from public view but available to interested

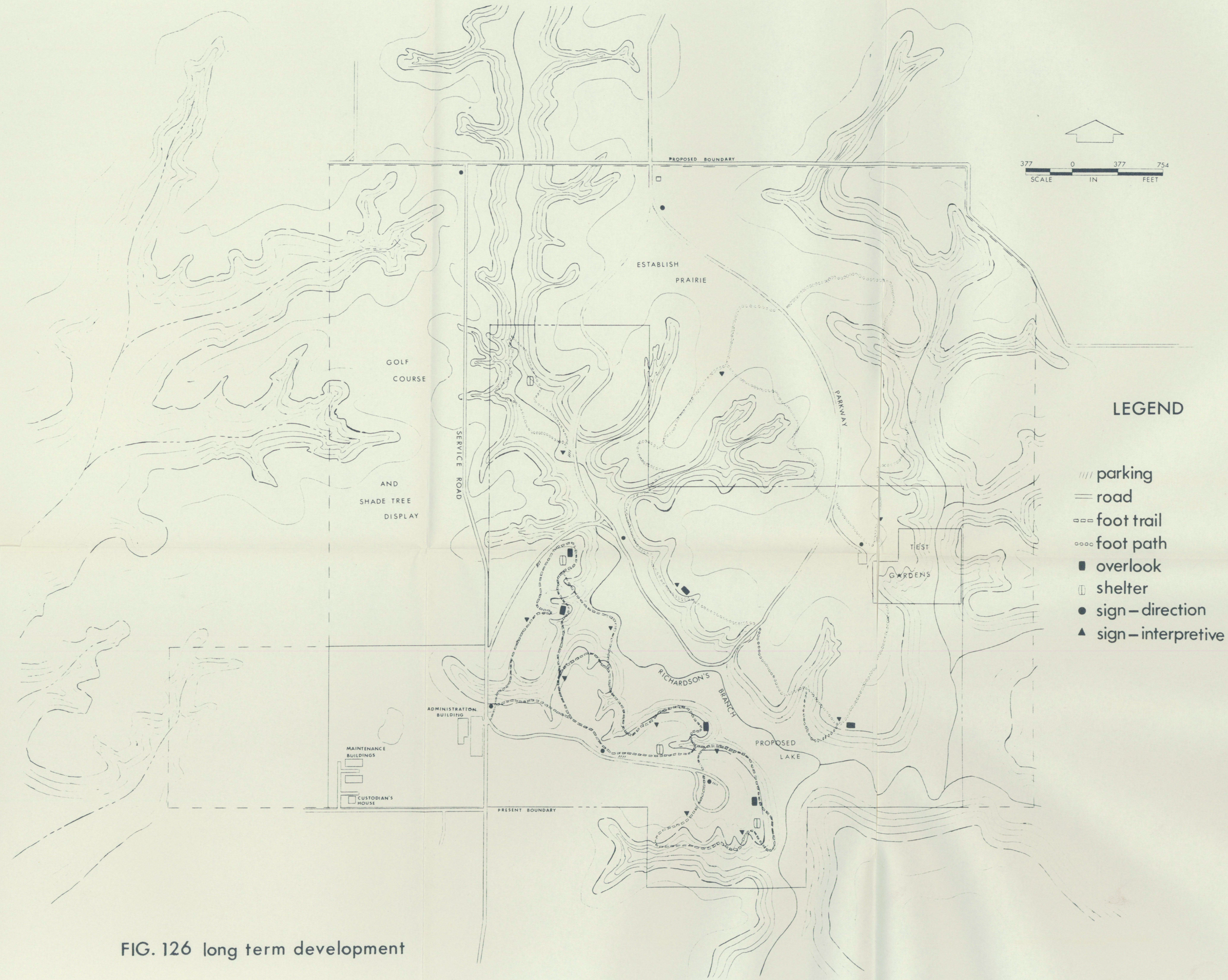



FIG. 126 long term development

visitors for study. The site utilizes topography to provide exposures to all directions as well as wet and dry elevations. Test gardens are located together for efficiency in maintenance.

Recommendations on maps indicate the preservation of wooded slopes and reconstruction of a prairie on portions of the summit. The region between wooded slopes and cultivated land represents an ecotone where various plantings could be blended into the background of overstory vegetation. This, then, would best fit the natural vegetation of central Iowa as described earlier. The floodplain and footslopes could be used as material that requires moist conditions, and bog areas and a proposed lake could support marine vegetation.

Fig. 126 indicates water near the southern edge of the property which will result when the 4-H Center constructs a reservoir on Richardson's Branch. It will be an asset to the Arboretum in supplying aesthetic beauty from overlooks and display areas for aquatic plants.

# SUMMARY

A study of overstory species occurring over 340 acres available to Iowa Arboretum, Incorporated was undertaken, utilizing a method of schematic diagrams to analyze forest cover types. The Arboretum was divided into 124 study areas by exposure and overstory vegetation. Analysis of these study areas indicate that black maple (Acer nigrum) was the most prevalent species and that the oak-hickory and maple-basswood associations dominate the overstory vegetation.

Schematic diagrams included all physical characteristics and disturbances in the area and were utilized in recommending a systematic procedure for the development of the Arboretum. Initial development recommendations include necessary facilities and services which require a minimum expense. Long-term recommendations include the development of all available land and the purchase and development of surrounding land for future expansion.

The method utilized in this survey can be duplicated to study in more detail the understory and undercover as well as periodic observations of the overstory to determine any change in dominance.

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